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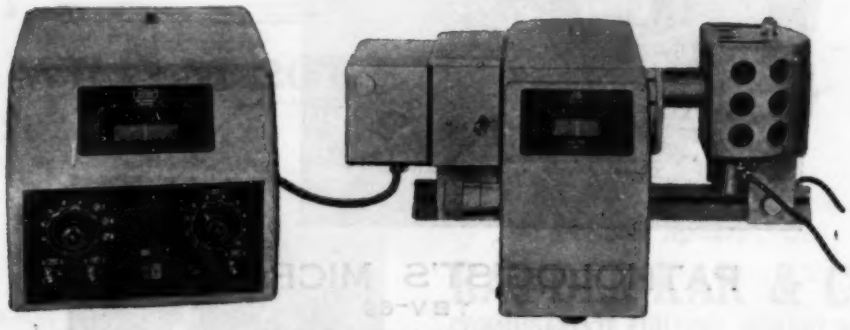

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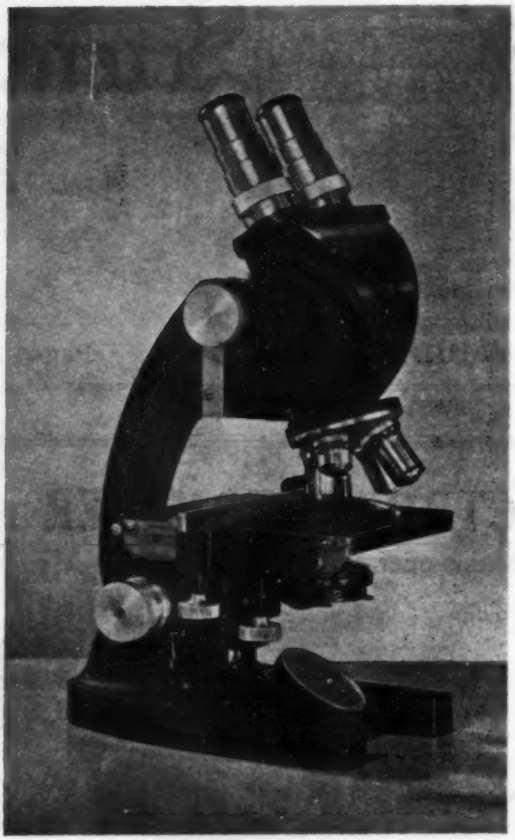

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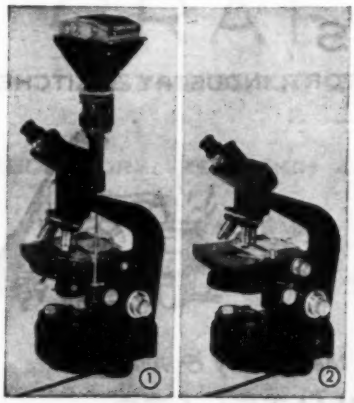

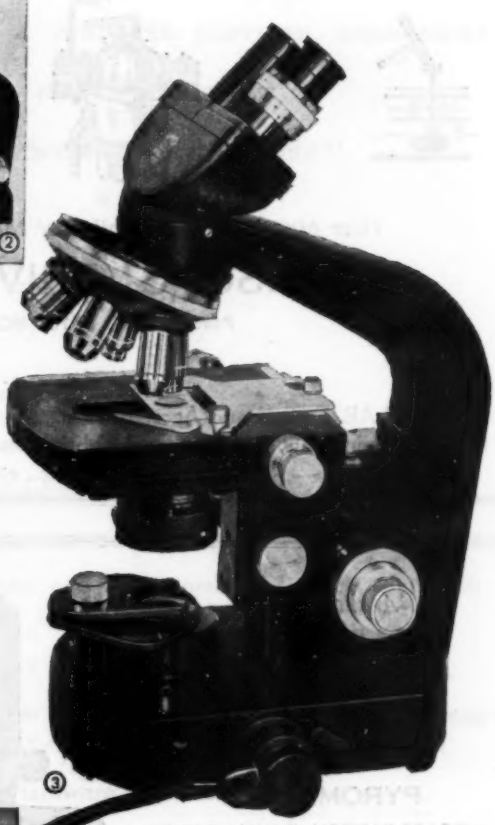

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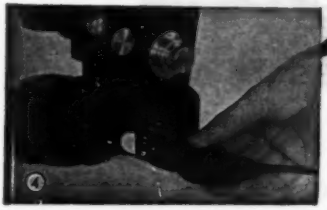

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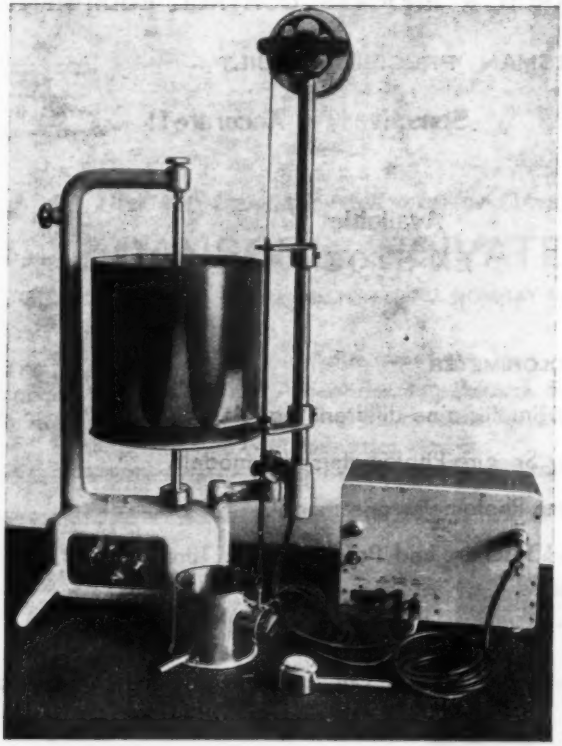

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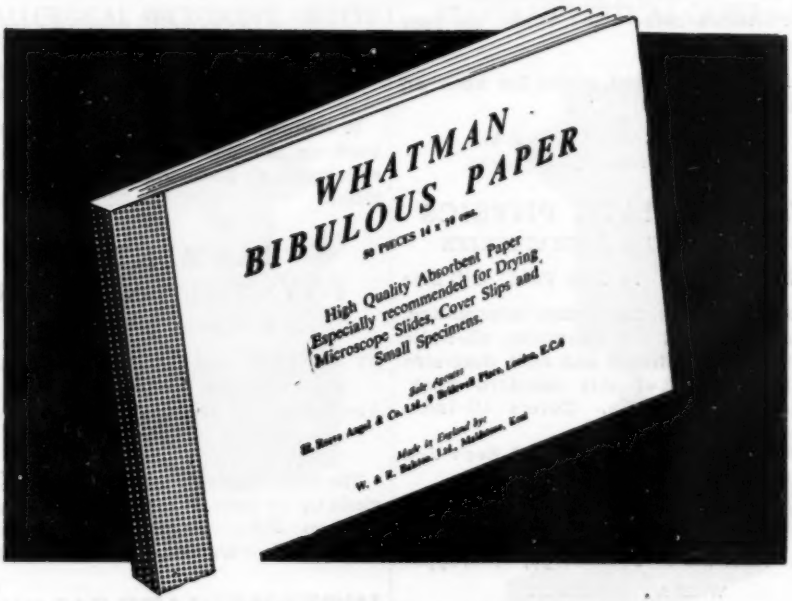
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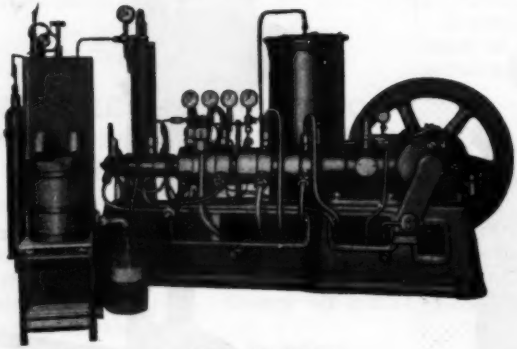

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PHYSICAL CONDITIONS IN SPACE

WHAT is it like in space? One of the main purposes of rocket research is to answer this question. Because of the thin protecting sheath of the atmosphere, conditions at the surface of the Earth have little resemblance to the inhospitable regions which commence only 30 or 40 miles above. These are the realms of the rocket—the beginning of space. It is a frontier full of activity and of interest, and one that is being penetrated deeper and deeper in the effort to extend our knowledge and understanding of the universe we live in.

At first, the atmosphere falls in density by a factor of about ten for every ten miles of ascent. But at a height of some 60 miles, the rate at which the density decreases begins to lessen, and the composition of the atmosphere begins to change rapidly as the action of the Sun's rays becomes more and more significant.

At a distance of several thousand miles, the atmosphere becomes almost indistinguishable from surrounding space. Here the solar and cosmic streams pass in undiminished intensity and together with the meteors constitute the most important factors in the environment.

The electrical and chemical activity of the upper atmosphere and interplanetary space is chiefly due to four kinds of energetic stream. First there is electromagnetic radiation—mainly X-rays and ultra-violet rays from the Sun; secondly, the Sun also emits streams of protons and electrons; thirdly, there are meteors; and finally cosmic rays.

In addition, electric and magnetic fields due to celestial bodies or to the movements of charged particles play their part, and of course, there are the gravitational fields of the Sun, planets and other bodies.

The commonest element in the universe is hydrogen. The Sun and the stars are largely made of it and it is everywhere in space. We expect to find at least 100 atoms in every cubic inch, but there might be far more, possibly 10,000. In any case, it will not be hydrogen as we are familiar with. It will be present in the atomic form, individual hydrogen atoms instead of pairs joined together to form molecules. Indeed, it may be still further dissociated, under the influence of the solar radiation, into protons and electrons.

Then there are the meteors, ranging in size from a few hundred-thousandths of an inch in diameter to boulders approaching asteroidal dimensions. Of course, the larger particles are extremely rare. In a hundred mile cube there is about one chance in ten of finding at any moment a particle big enough to give rise to a shooting star, even though on entering the Earth's atmosphere a speck the size of a pin's head would become visible to the naked eye.

How hot is it in space? This is the next question that comes to mind and it is a difficult one to answer, partly because we do not know and partly because the question is more involved than it appears. If we take a thermometer and hang it in a room, away from the fire it will give us the air temperature. If we blacken the bulb and put it in the midday sun, it will read a rather high temperature which does not correspond to anything very exactly, but has something to do with the intensity of the solar radiation. If we wrap the bulb in polished zinc it will read still higher. If we paint it white it will read less.

The same kind of thing is true in interplanetary space. A rocket or satellite will take up a temperature, dependent upon the nature of its surface, and having virtually nothing to do with the temperature of the surrounding gas. The temperature of the gas which is really a measure of the velocities of the atoms, may be quite cool or it may be 10,000° C. Again we do not know. It depends on the intensity of the solar radiation in the unexplored very short ultra-violet part of the spectrum.

Among the least inviting aspects of interplanetary space are the solar and cosmic rays. The Sun's chromosphere emits ultra-violet light having a most deleterious effect on organic materials such as rubber, to say nothing of living organisms. In addition the corona emits intense soft X-radiation.

From disturbed regions on the Sun, streams of charged particles, protons and electrons are shot out and it is these which after deflection in the Earth's magnetic field give us the auroræ and magnetic storms which we associate with solar disturbances.

Solar rays and corpuscles and meteoric particles could have a damaging effect on satellite surfaces and especially on the windows of solar batteries and of radiation detectors, but protection could be provided and for a limited time effects would be small.

Cosmic rays, however, present quite another problem. These are the most energetic of the fundamental phenomena of nature. Mostly, they consist of protons with energies up to a million million million electron volts but there are also heavier particles. They all have an

immense penetrating power and the heavy particles produce intense ionization along their tracks. This is because, being stripped of their electrons, they carry a high charge. In some physical experiments the effect of cosmic rays present an appreciable disturbance, but it is generally possible to correct for this. The chief interest in the heavier particles concerns their damaging effect on living tissues.

A start on the solution of many of the problems of interplanetary space is being made with the present series of satellite launchings. For most of these studies a deep penetration is not required, and many of them only require altitudes up to a few Earth radii.

It seems certain, therefore, that the problems of interplanetary space should soon be yielding to an invasion of that territory, not by men or dogs, but by well-instrumented satellites.

RECENT DEVELOPMENTS IN ION-EXCHANGE

ONE of the most interesting developments in the field of ion-exchange during the past few years has been the return of interest in inorganic ion-exchangers.

The materials which have been investigated are not the natural or the more recent synthetic zeolites but comparatively simple metal oxides and salts. Precipitates of hydrated oxides such as aluminium hydroxide can behave as either cation or anion exchangers, and the effect has been observed with such metals as zirconium, uranium, thorium and tin.

When zirconyl nitrate, for example, is treated with alkali, the resulting precipitate has an open gel structure cross-linked with -Zr-O-Zr-O- bridges and containing free hydroxyl groups. Such precipitates may be treated with acids such as phosphoric, arsenic or tungstic acids to yield very insoluble products which are stable to high temperatures and contain groups such as the H_2PO_4 group in addition to the hydroxyl group, and which therefore have both anion and cation exchange properties. These materials behave differently at different pH values. These new ion-exchange materials are particularly suitable for the analysis and separation of the alkali metals.

The tedious nature of chromatography upon ion-exchange resins with the necessity of developing specific or selective eluting agents has led to an interest in the production of ion-exchange materials containing functional groups which might be hoped to react in a specific manner. The first attempt to prepare a resin with selective chelating properties involved the preparation of a polystyrene containing di-picrylamine groups and this was shown to have a greater affinity for potassium than the conventional resins containing carboxyl or sulphonic acid groups, as would be expected from the insolubility of the potassium salt of di-picrylamine.

A further development of the ion-exchange technique has been the production of ion-exchange papers. Ion-exchange properties may be conferred upon filter-paper by the introduction of active functional groups into the cellulose structure. Such groups have included the sulphonic and carboxylic acid, the quaternary ammonium and the phosphoric acid groups.

Ion-exchange materials in the form of membranes permeable to water have also interesting properties and uses. The anion exchanger is permeable only to anions and the cation exchanger is permeable only to cations, while both have a low electric resistance. With such membranes replacing the conventional semi-permeable membranes, the process of electro-dialysis becomes much more efficient and can be used for the desalting of solutions of amino acids such as are obtained in the hydrolysis of proteins. Another use of these membranes is in the determination of the activities of ions and this facility is valuable for ions for which reversible electrodes are not available. These include fluoride, nitrate and acetate.

Protein mixtures have been successively separated upon columns of ion-exchangers but because of the large molecular size of the proteins, the effect was confined to the surface of the resin. Recently attempts have been made to improve the efficiency of this process by providing exchangers with a more open structure. Three types have been described, one in which an inorganic material with a porous structure such as kieselguhr is coated with a sulphonated polystyrene, another in which the resin itself is expanded and made porous and a third which uses chemically modified cellulose which is permeable to the large molecules. (*Chemical Products*, April 1958.)

DARWINISM THROUGH HUNDRED YEARS

P. K. MENON

Dept. of Zoology, Presidency College, Madras-5

IT was an uncommon coincidence in the history of science that two tireless naturalists, Darwin and Wallace, should have been writnig up their views on the problem of the origin of varieties and species in nature at the same time in different places unknown to each other, and should have come to nearly identical conclusions. Wallace was then in the Malay Archipelago. His essay "on the Tendency of Varieties to Depart Indefinitely from the Original Type", was sent to Darwin for perusal and subsequent communication to Lyell for publication if found fit. Darwin, on the other hand, at the persistent insistence of Lyell and Hooker was writing up his theory of Natural Selection which he had conceived clearly even in 1839, on the basis of his laborious collections and studies particularly during his 5-year voyage in the Beagle. This was early in the summer of 1858. The receipt of Wallace's essay created a crisis in Darwin's life. But true to his character and generosity his first reaction was to hold back his own work and allow Wallace's to be published. Lyell and Hooker had to use all their powers of persuasion to make Darwin consent to have an abstract of his own manuscript published along with Wallace's essay in *The Journal of the Proceedings of the Linnean Society*. This was the epoch-making Darwin-Wallace essays of 1858, of which the centenary is now being celebrated. Lyell and Hooker did not stop at that. They pressed Darwin to prepare a volume on his theory. At the end of more than a year of hard work, the volume was published in 1859 under the title, "On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life". (The "Origin of Species" or "The Origin", for short.)

It is implied in the title itself that Natural Selection is not Evolution. The two are different facts of nature. According to Darwin, and it is generally accepted, the former is the means by which the latter is brought about. This causational relation between the two is the essence of the theory of Darwin, what has come to be known as Darwinism. Though the credit for putting the concept of evolution on a scientific basis of facts of nature is mainly Darwin's, the concept is much older than Darwin. Even the Greeks had realized that change was the essence of existence.

Darwin's achievement was not the collection of the enormous data to support his theory. Anybody with patience and industry could have done that. Nor was the principle of Natural Selection altogether his own. His inspiration for it was from Malthus's Essay on Population. His real achievement was, as Carter says (1957), that from such simple and common premises he "produced the fundamental and, to his contemporaries, novel results of his proof of the truth of evolution and his theory of its causation". To those who accepted it, it provided a unifying concept in the light of which organisms ceased to be isolated entities, and came to be understood as part of the single flux of life continually changing with the changing world. Darwin gave Biology an intelligible background and made it logically comprehensible.

The early reaction to Darwinism was from two sources, from the general public and the biologists. There was fierce sentimental opposition from a section of the public to evolution and its method as expounded in Darwinism. So, it is no wonder that the simple forthright interpretation of evolution by Darwin in terms of fortuitous events leading to order and seeming purpose through Natural Selection was unpalatable to them as it conflicted with their ideas of the Creator and Design. The climax of this was reached at the Oxford Meeting in 1860 at which Bishop Wilberforce deliberately attempted to "smash Darwin" and ended up in being smashed by Huxley.

The more important point was the reaction of the biologists to Darwin. Generally, the biologists of the day reacted favourably, but it should not be imagined that all the biologists acknowledged the theory without adverse criticism. There were many points of criticism which were valid and real weaknesses of Darwinism. The following few among many are noteworthy.

1. Though Darwin had observed variations and realized their basic importance to evolution, he was fully ignorant of their causes or nature. He himself admitted and deplored it and considered the so-called acquired variations also as important to evolution. He even went to the extent of suggesting a mechanism of inheritance in the form of his theory of *pangenesis* which however never deserved and

got any acceptance. It was exactly this gap in Darwinism that was filled by modern genetics.

2. Evolutionary change involves co-ordinated changes. For example, an increase in the size of the body will need many correlated changes if the animal is to be efficient. Darwin almost overlooked this fact in his thesis. Perhaps he did not consider it as a serious difficulty to his view of evolution by accumulation of small variations. However, such correlated changes are not now difficult to understand in terms of polygenes and pleiotropism (Dobzhansky, 1951), and allometric changes (Huxley, 1932).

3. Those whose biology was based on *Naturphilosophie* did not easily accept Darwinism, as it was not an answer to their quest for the Absolute idea or the Divine plan of Nature or the conception of the archetype. To them law was something immutable, to Darwin it was a deduction from known facts.

4. Many other criticisms, which then looked like real difficulties have lost their point in the light of the new knowledge. One such related to complex structures like the vertebrate eye. The question was, could they have been of any use in the initial stages when they could have hardly functioned? If not, how could they have been selected? A study of the light-perceiving organs in the animal world makes it readily clear that even the simplest of them like the eye-spots of the green flagellates have been functionally efficient at their level. So evolution has not only been in structure but also in function. This removes the seemingly insuperable difficulty to accept the complex organs as the products of Natural Selection.

During the forty-one years of the 19th century after the publication of the "Origin", evolution came to be almost fully accepted, thanks partly to the championship of Thomas Huxley in England and of Haeckel in Germany. Huxley was a competent biologist himself and had no difficulty in winning the battle for Darwin. Haeckel too had accepted Darwinism, but his version of the theory was tinged with *Naturphilosophie*. His chief contribution was the theory of Recapitulation which was almost *Naturphilosophie* with the commonness of descent instead of the archetype. It was quite contrary to Von Baer's laws of ontogenesis. In the later years of the 19th century, Darwinism remained practically unchanged except for the rejection of the Lamarckian part of it along with Lamarckism in general, as a consequence of the Weismannian theory of the isolatedness of the gonad from the soma, so as to leave the former unaffected by the changes of the latter. In this period there was little progress in evolutionary biology, but there was an enormous output of morphological work in the several branches of biology. Much of it was by way of attempting to prove evolution and Natural Selection. It was only towards the end of the century that experimental embryology began to change the outlook of biologists a little.

The present century began with evolution well established as a fact, except for those who did not want to accept it. The almost total acceptance of evolution restricted the field of discussion and controversy to the means by which evolution took place. By the close of the 19th century, Darwinism too had been accepted as the means of evolutionary change. The idea had penetrated all aspects of human thought.

The history of Darwinism from the beginning of this century is a good example of how a comprehensive scientific concept undergoes change and refinement by impact of growing and more precise knowledge. The most important factor that affected Darwinism in the last 58 years was the rapid growth of the science of heredity, *i.e.*, genetics. "This supplied the missing parts of the structure first erected by Darwin" (Fisher, 1930). The basis of modern genetics was the laws of Mendel published in the latter half of the 19th century. They were far ahead of the times and remained unknown till they were rediscovered in the beginning of this century. The particulate nature of inheritance discovered by Mendel had revolutionary effects on the understanding of evolutionary problems.

Darwin had imagined the hereditary characters of the parents to blend in the progeny like water and milk. That would result in a levelling off of variations to uniformity in the members of a population, and would defeat selection. This was the most serious difficulty in Darwinism and it was obviated by Mendelian particulate inheritance. As shown by Fisher (1930), if inheritance had not been particulate evolution as we know it would not have been possible. Mendelian heredity provided a mechanism for both inheritance and variation, the conservative and the progressive aspects of evolution.

At this stage it may look strange that the first result of the Mendelian studies was to create a degree of disbelief in Natural Selection. De Vries's work on the evening primrose

was published in 1901. He had noticed that many new forms suddenly appeared among his plants and bred true. He called such changes "mutations" and contended that evolution took place at least partly through such abrupt changes without involving the Natural Selection of small variations. Natural selection acted in such cases only after the origin of the new form, conserving or eliminating it. Bateson also held similar views. This gave a new importance to the distinction between the continuous and the discontinuous variations in regard to the process of evolutionary change. Darwin had attached little importance to the discontinuous variations. That accounts for the temporary loss of faith in Natural Selection. Mendelism seemed to conform to the views of these doubters of Natural Selection because of the apparent possibility of the large changes of De Vries and Bateson being inherited as Mendelian units. It was soon found, however, that many kinds of characters of organisms were inherited in the Mendelian manner. Meanwhile Morgan and others discovered the cytological basis of Mendelian inheritance in terms of chromosomes and genes, and their behaviour in reproduction. It will be going too far from the topic to consider the progress of genetics in the last fifty years. Suffice it to say that in this period, genetics became in itself an exact body of science and illumined many dark corners in biological knowledge, particularly in evolutionary studies. The understanding of genetic variations, mutations in the wide sense, their nature and frequency and even some of their causes (Muller, 1927), the problems of population genetics, the conceptions of the genotype and the phenotype, clarified and strengthened Natural Selection steadily and surely. But as mentioned earlier, the first impact of genetical knowledge on Darwinism had the unexpected result of many giving up the theory. It is not difficult to understand either. Darwinism involved the gradual accumulation by Natural Selection of small-graded changes. This was the indication of palæontological studies too. On the other hand, the early genetics dealt with changes that could be readily and easily noticed and so were of the discontinuous type. It seemed impossible to the leading biologists of the day that the observed evolutionary changes could be the result of selection of such genetic changes. This led to violent clashes in the biological world in the first two decades of this century. Bateson took an extreme view and declared that the Darwinian theory had collapsed. He went to the extent of reverting to a sort of preformationism in evolution, involving the progressive expression in organisms of the potentialities that had existed from the beginning of evolution. Many took up similar though less extreme views.

The real point at that time was whether the small variations on which Natural Selection was said to act were also Mendelian. This was not discussed then, as probably it could not have been in that state of genetical knowledge. The discussion was concentrated on whether the continuous or the discontinuous variations were the raw materials of evolution. This was a wrong question to ask and largely accounts for the biological stalemate of the time. This was resolved by further genetical studies in the recent decades. Two important advances in the field of genetics contributed to this. One was the new outlook on the genotype, and the other the new approach to studies of natural populations and their genetics. These also threw revealing light on the operations of Natural Selection.

In the earlier decades of the century a genotype was considered more or less as an aggregate of genes, each with a degree of independence of action. Recent decades brought the realization that the genes of a genotype constitute an intricately interacting system and that the phenotype is the product of such combined action of the genotype and the environment. A mutation in such a system will have its effect much modified by the other genes present and also by other mutations. Since individuals in a population vary in their genotype the effect of a mutation also will vary correspondingly. Further, when many genes may influence a character and any one gene may influence many characters the phenotypic expressions of the individuals may show the gradation observed in the palæontological studies of evolutionary changes, and envisaged by the theory of Natural Selection. It is true that a mutation is inherited as a unit, all or none. But its expression in the individual depends on the genotype and the environment. That explains the varying effect of mutation on individuals. However, it should not be forgotten that there are many known instances of mutations with phenotypic effects very distinctive and inherited like the characters of Mendel's peas. The pigmentation in what is known as "industrial melanism" is one such. They are comparatively rare. Normally in nature the differences are those based on many genes and varying in degree. This understanding

brought about a reconciliation between the geneticists and the selectionists and the objection of Bateson and others thus disappeared. It also became clear that selection was not directly of the genotype but through the phenotype. Selection of a particular phenotype meant the selection of the genotype that produced it. It is largely a case of selection of the favourable recombinations of genes and allows for a margin of phenotypic adjustment to environmental variations. In the course of generations the more suitable gene combinations become more numerous in the population. In this process the favourable mutations that may arise may be incorporated into the genotype. The first effect of any mutation is usually a discordance as it is something new in a harmonious system. But subsequent selection will integrate it into the genotype if useful, or eliminate it if harmful. Either way, the harmony is restored which implies that a mutation has to undergo a probation before it is accepted as a full member of the genotype with suitable modification of its action by the rest of the genotype (Huxley, 1942). Natural Selection in this sense is the differential survival of the favourable genetic variants.

The slowness of selection makes observation of changes very difficult, if not impossible, but something like it has been observed in recent times. Germs are known to develop resistance to antibiotics rather quickly and this is obviously a case of selection of the favourable genotype at the expense of the others, in the presence of a new factor in the growth medium, the antibiotics (Demerec, 1950). Varieties of Drosophila kept in equal numbers in set environments have been found to undergo selective survival in relation to the environment. Green *Mantis* was found to survive largely when tied on green grass but mostly eaten by birds on brown grass. On the other hand, brown *Mantis* survived on brown grass but got decimated on green grass. The selective advantage of harmonising colour is thus demonstrated. These may not be true pictures of selection in nature. But their value is significant.

The new knowledge of selection in genetical terms has in its turn clarified the nature of the changes within a species and between species. That brings us to population studies, another sphere of advance in recent times. The world of biology owes tremendously in this connection to the brilliant mathematical analyses of the genetics of population and selection by R. A. Fisher (1930), J. B. S. Haldane (1932) and Sewall Wright (1942). To this must be added the names of Dobzhansky, E. B. Ford and E. Mayr. Their expositions of the interactions of selection, mutation and the other factors of evolution in populations have made possible the synthesis of varied observations and experimental results into a coherent thesis (Simpson, 1942).

The subtle ways of the operation of Natural Selection, and evolution by selection are now satisfactorily understood. The obvious fact that some individuals in a population leave more progeny than the others makes Natural Selection inevitable. This ability to leave more progeny than others in a particular environmental setting is the real fitness in the Darwinian sense. The well-known expressions "struggle for existence" and "the survival of the fittest" were used by Darwin in a metaphorical sense. "I should premise," said Darwin in the 'Origin', "that I use this term in a large and metaphorical sense including....success in leaving progeny." The convenient literal interpretation of the expressions by some persons is quite unwarranted. Reproductive success based on advantageous genotype is therefore the essence of evolutionary change. A population will gradually change in the direction of the genotype which continues to leave more progeny in successive generations. This is how Natural Selection directs evolution using the 'random' genetical variations as the raw material. This is the most significant contribution of the present century to the understanding of Darwinism.

This article is an attempt to trace the history of the theory of evolution by Natural Selection, during the hundred years since Darwin and Wallace propounded it. In the period the theory has been knocked into a cocked hat. But the core of it has stood the test of time. Generally it is adequate to explain the process of evolution, but there are still many problems of evolution, particularly in regard to the large evolutionary changes, which it is not adequate to explain. Most of the biologists agree with Darwin that varieties are incipient species and that species differ from varieties only in the greater degree of divergence making their natural interbreeding difficult or impossible. Some authorities like Goldschmidt (1940) do not agree with this view. He postulates radical mutations which he calls 'systemic mutations' to produce species differences. How such radical changes in individuals with integrated genotype can leave them viable is difficult to see.

There are others who are not convinced of the effectiveness of selection in regard to all the known evolutionary changes. Many bring in the Lamarckian factor in some sort of way. One of the latest is C. H. Waddington (1957). In terms of "genetic assimilation", "epigenetic landscape" and "canalized development" he suggests a causal relationship between an effect caused by the environment and the production and the selection of appropriate mutations. A phenotypic alteration within the normal range of expression of the genotype is understandable. There is no difficulty to see how such a change may help an organism to tide over a reasonable period during which the genotype may be harmonized to the new conditions by selection of appropriate mutations. The difficulty is to understand how enough of the suitable mutations arise at the right time. One possibility is to suppose that mutations are so common and varied as to supply the needed ones. To Waddington this is probably too much to suppose and so he postulates a developmental mechanism.

Fisher (1930) summed up the position as follows:

"The sole surviving theory is that of Natural Selection, and it is impossible to avoid the conclusion that if any evolutionary problem appears to be inexplicable on the theory, it must be accepted at present merely as one of the facts which in the present state of knowledge seems inexplicable." Since this was written many more problems have been explained. But many still remain and the words are still true. It is also implied that with the continued progress of knowledge the area of the inexplicable problems will progressively diminish.

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FISCHER-TROPSCH PROCESS

THE traditional form of fixed catalyst bed in the early Fischer-Tropsch process was a very inefficient arrangement, both as regards aerodynamics and heat transfer and this, in part, accounted for the very wide range of synthetic products produced. The fluid bed has been one device adopted to minimise these variations between different parts of the solid bed. The use of a genuine liquid bed for catalysis is a stage further. In this case the catalyst is suspended in a liquid through which the gaseous mixture rises in a constant stream of bubbles. The finely divided catalyst, with an average grain size of approximately 5 μ, collects at the surface of the rising bubbles and is constantly renewed there. The temperature can be kept remarkably constant, variations being not more than about 1° C. At temperatures of 250-300° C. and at pressures of 8-15 atmospheres, the synthesis gas is converted into hydrocarbons to the extent of over 90% in a single passage through the bubble column. The heat of reaction is removed by a cooling coil suspended in the bubble column and is converted into steam. Whereas by the traditional method the conversion of 1,000 m^3 of synthesis gas per hour required a cooling surface of 3,000 square meters, in a bubble column type of catalyser less than 50 square meters surface is required and the capacity of a single reactor has been raised from approximately 2·5 tons of hydrocarbon per day to 50 tons per day. The method has been used not merely for the hydrogenation of carbon monoxide but for the direct creation of carbon monoxide with water, according to the equation $3\,CO + H_2O = -CH_2 + 2\,CO_2$.

STACKING FAULTS IN CLOSEPACKED METALLIC LATTICES

Part I. The Nature and Origin of Stacking Faults

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Introduction

IN solid metals, the atoms or positive ions are held together by a cloud of free electrons and each atom tends to be attracted equally to all its nearest neighbours. The majority of metals crystallize therefore in highly close-packed structures.

A closepacked atomic lattice can be visualized as a regular pile of closepacked atomic planes. The atoms in each plane lie in three sets of lines (Fig. 1) which are physically equivalent and 120° to each other. If the letter A represents one such plane, the next plane can be put above it in two possible positions represented by letters B and C. Any arrangement or mode of stacking of planes of types A, B and C gives a closepacked structure, provided no two successive layers are alike. The closepacked metallic lattices normally exhibit either the ABCABC— or the ABABAB— sequence. The former is the so-called face-centred cubic (f.c.c.) structure adopted by common metals like aluminium, copper, gold, nickel and silver. The latter is the hexagonal closepacked (h.c.p.) structure exemplified by metals like cadmium, magnesium, titanium, zirconium and zinc. Cobalt is an interesting metal which exists in both modifications.

The f.c.c. and h.c.p. structures are the only two perfectly regular of the common close-packed structures. Any other sequence of layers, subject only to the condition that any two adjacent layers must be in different positions, is still closepacked, but has to be considered a faulty f.c.c. or h.c.p. structure. Any break in the sequences ABCABC— and ABABAB— is normally referred to as a *"stacking fault"*. The existence of such stacking faults in metallic lattices was first detected in 1942 in the case of h.c.p. cobalt.[1,2] It is now known that stacking faults are introduced fairly commonly in metals by plastic deformation or phase transformation, and also during crystal growth. Such faults may be distributed randomly, clustered together or arranged more regularly in the lattice. They contribute to the anomalous broadening of X-ray reflections and have recently been recognized as playing an important role in the work hardening of metals.

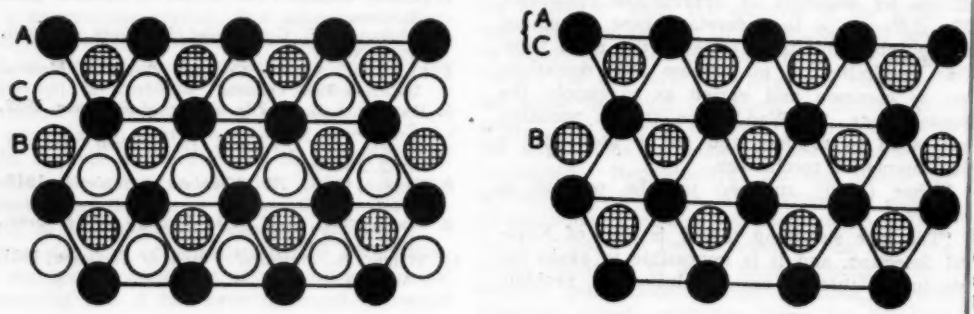

FIG. 1. Formation of closepacked lattices from closepacked atomic planes (B and C are the two possible positions for the plane above A. A_1 and A_3 are the f.c.c. and h.c.p. sequences respectively).

Laws of Growth and Deformation Faulting

It is common practice to classify stacking faults in closepacked lattices into *"growth faults"* and *"deformation faults"*. The differences between the two types are easily understood on the basis of simple laws for their formation.

The law of growth faulting for the f.c.c. structure is that each atomic plane is displaced relative to the two planes immediately beneath it, except at a fault where it is above the plane next but one below it. For the h.c.p. structure, each plane is above the layer next but one below it, except at a fault. Typical sequences of planes are thus:

ABCABCBACBAC .. f.c.c. growth fault

ABABABCBCBCB .. h.c.p. growth fault

The f.c.c. growth fault produces a twin orientation, an ABCABC— sequence being converted to a CBACBA— sequence. In the h.c.p. structure, however, owing to the different symmetry, the two halves have the same orientation and differ only by a translation. A growth fault introduced at each plane of the h.c.p. lattice produces the f.c.c. lattice and *vice versa*. There is thus a continuous transition between the two structures represented by an increasing number of randomly distributed growth faults.

The law of deformation faulting for both structures is that the lattices on either side of the fault have identical orientation, but the two halves are displaced parallel to the closepacked planes. Typical sequences of planes are thus:

ABCABCBCABCA ..	f.c.c. deformation fault
ABABABCACACA ..	h.c.p. deformation fault

For both structures, therefore, a deformation fault can be considered equivalent to a cluster of two growth faults on neighbouring atomic planes.

A deformation fault introduced at every plane of an f.c.c. lattice gives an f.c.c. lattice of twin orientation. Similarly, one h.c.p. sequence is converted to another h.c.p. sequence by including a fault in each plane. Thus there is no continuity between the two lattices as in the case of growth faulting. A random arrangement of growth faults in either structure produces therefore quite different X-ray diffraction effects from the corresponding structure with a random arrangement of deformation faults.

The laws postulated above implicitly assume that a stacking fault extends over the whole of an atomic plane. In reality, however, a fault may occupy part of a plane and be bounded by what are known as "imperfect dislocations" in the lattice. It is not possible with present experimental methods to establish whether stacking faults occupy part or whole of the atomic plane. The quantity that can be experimentally measured by X-ray methods is α, the frequency of faults or faulting parameter, which can be defined as the ratio of the total area of faults to the total area of closepacked planes. Such measurements are further based on the assumption that the faults are *randomly* distributed in the lattice.

Stacking Faults from Crystal Growth

If a closepacked lattice is built up by the successive growth of closepacked atomic layers in such a way that each layer forms from a fresh two-dimensional nucleus, there will be a finite probability of a layer going into the wrong position. When the kinetics of growth are such that the rate-limiting factor is the time to form the two-dimensional nucleus, the latter will spread rapidly over the plane after attaining a critical size. If a stacking fault is nucleated, it will occupy most of the plane. This is the situation envisaged in the law of growth faulting. It might arise during electrodeposition, growth from the vapour at high degrees of supersaturation and in certain types of nucleation and growth phase transformations. Fine twinning that can be observed in electrodeposited copper has been attributed to growth faulting.[3] Since these twins are visible microscopically, the faults seem to occur once in a few thousand atomic planes. X-ray diffraction effects become appreciable only at values of α corresponding to a twin thickness of less than a hundred atomic planes.

It is also possible, especially in transformations requiring long-range diffusion, that the rate of growth of a layer is small compared to its rate of nucleation. Growth faults will then form more readily, but will seldom grow to dimensions of the order of a whole plane. An aluminium-silver alloy with 30% silver prepared by condensation of the vapour has been found to contain both h.c.p. and f.c.c. phases together with a faulted structure at the junction of the two phases.[4] Growth faults have also been reported in vacuum-deposited pure silver,[4] but neither effect has been studied quantitatively.

Faulting Due to Martensitic Transformation

The formation of growth faults during martensitic transformations (*i.e.*, athermal, solid-state transformations involving simultaneous and co-ordinated movement of atomic planes in the lattice) has been clearly demonstrated in the case of h.c.p. cobalt[1,2] and h.c.p. lithium.[5] Quantitative estimation indicates that the faults are of the order of one in ten atomic planes in cobalt and even more in lithium. The faults in cobalt are of a rather complex nature and the results are often consistent only if the faults are assumed to be not completely random, but clustered together.[6]

The origin of faults during martensitic transformation has not yet been clearly understood. Such transformations are supposed to take place homogeneously with a macroscopic shear[7] and so, faults can arise only when transforming domains from different nuclei meet out of phase or when the transformation proceeds inhomogeneously in the regions between the macroscopically sheared layers already formed. The

magnitude of the faults is far too much, however, to be explained this way. In h.c.p. cobalt, the most extensive faulting is observed in specimens which have been plastically deformed to assist the f.c.c.→ h.c.p. transformation. Such specimens then contain both growth and deformation faults,[6] whose combined effects cannot

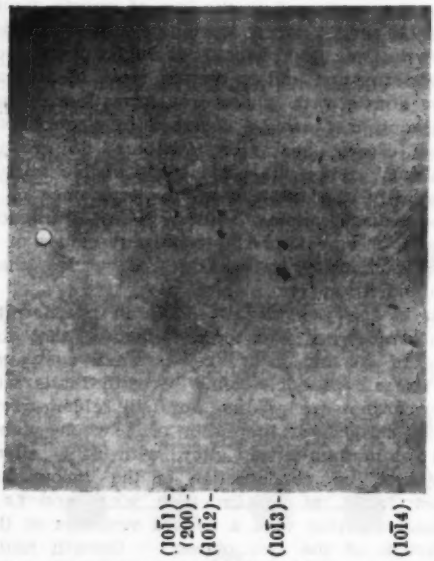

FIG. 2. Streaks due to stacking faults in an oscillation photograph of a grain in a massive cobalt specimen (Ni K_α radiation, range of oscillation 15°).

be easily separated for reliable quantitative estimation of either.

Origin of Deformation Faults

In 1952, exactly ten years after the first detection of stacking faults in a metallic structure, the suggestion was put forward[5] that a large part of the X-ray line broadening of cold-worked metals or alloys might be due to stacking faults. Evidence for the presence of deformation stacking faults in cold-worked closepacked metals is now available in the case of α-brass,[8] h.c.p. cobalt,[6] nickel and silver,[9] gold,[10] nickel-cobalt alloys,[11] copper and a number of its binary alloys[12] and a few martensitic steels.[13] The faulting parameter varies in such cases in the range 0·001-0·05. In some instances,[11-13] interesting correlations have been arrived at between the incidence of deformation fault and changes in electrical and mechanical properties.

Deformation faults are supposed to arise by the slipping or gliding of closepacked atomic planes over one another during mechanical deformation. In the case of an ABABAB— h.c.p. sequence, deformation faulting can occur only by both A and B planes gliding to the C positions. These are opposite so far as arrangement is concerned, but only require atom movements at 60° to each other and hence may be produced by the same shear stress.

Detection and Evaluation of Stacking Faults

As pointed out earlier, the detection of stacking faults as well as the quantitative evaluation of the faulting parameter is possible only by X-ray methods. The effects of stacking faults on X-ray diffraction from faulted closepacked lattices have been worked out in detail by several authors and can be best understood in terms of the reciprocal lattices of the two closepacked structures. In Part II of this review, a simple, composite picture of the X-ray diffraction effects of the four types of stacking faults will be given. A clear understanding of these effects is absolutely necessary for both qualitative as well as quantitative determination of the faulting parameter.

In general, the presence of stacking faults is revealed by streaks (Fig. 2) in Laue and Oscil-

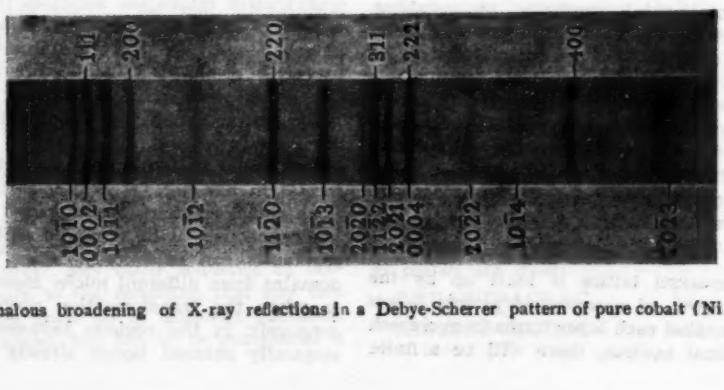

FIG. 3. Anomalous broadening of X-ray reflections in a Debye-Scherrer pattern of pure cobalt (Ni K_α radiation 9 cm. camera).

lation photographs and by the anomalous broadening of some lines (Fig. 3) in Debye-Scherrer patterns. These streaks and broad lines are easily detectable when the faulting frequency is greater than one in fifty planes. The establishment of the actual type of faulting as well as the accurate measurement of the faulting parameter is, however, possible only through a detailed study of the nature of the streaks or line-broadening, as dealt with in Part II of this review.

(To be continued)

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ORIGIN OF RADIO BURSTS FROM THE SUN

AUSTRALIA has shared with Cambridge and Manchester in the advancement of the still young science of radio astronomy to a position in which it contributes seriously to many different branches of astronomy. A method of following the course of radio bursts from the sun—that remained for several years "special" to Australia is believed to be within sight now.

The originator of the method was Mr. J. P. Wild of the Radiophysics Laboratory, the Commonwealth Scientific and Industrial Research Organization. Mr. Wild's first apparatus was begun in 1948, and a second and much bigger instrument completed in 1952. By this time there was comparatively little activity on the sun, and often weeks would go by without anything of interest being recorded. However, there was enough experience to enable the main kinds of radio burst to be distinguished and tentatively interpreted; during recent months there have been several bursts a day, and observations of a new kind have been made.

The main instrument consists of a trio of directional receivers, each capable of scanning a wide band of frequencies at half-second intervals. The frequencies covered a range from 40 to 240 megacycles a second, corresponding with a wavelength range from 1·25 to 7·5 metres. Records of intensity against time are displayed on a cathode ray tube, and in normal use are recorded photographically. For quick reporting of activity in connexion with the International Geophysical Year, a facsimile system has been introduced, similar to that used in transmitting pictures by radio.

The two most interesting types of radio burst differ greatly in their speed of development. In both there is a drift from higher frequencies to lower as the burst proceeds. But whereas a "slow-drift burst" may last for 10 minutes or so, a "fast-drift burst" is over with in a few seconds. The theoretical interpretation—plausible but so far unproved—is that the different frequencies observed correspond with natural frequencies of oscillation at different heights in the sun's atmosphere. Hence, it is suggested, an outpouring of particles from the sun's surface stimulates successive layers of its atmosphere to act as a source of radio waves, each at its own frequency, or a harmonic of it. In this way—provided that the explanation is correct—it has been possible to work out what the outward speeds of the particles should be, so as to correspond with the observed drift in frequencies.

In the case of 'slow-drift burst' the speeds deduced are usually from about 200 to 400 miles a second, and the disturbances can be followed—again if the explanation is correct—to distances above the sun's surface nearly as great as the radius of the sun. Such speeds correspond well enough with the interval between the bigger optical flares that can be seen on the sun and the beginning of auroal displays and magnetic storms that particle-streams, arriving from the sun, are thought with good evidence to cause on the earth. Also the "slow-drift bursts" are usually accompanied by big visual flares.

"Fast-drift bursts" are much more common. Sometimes one at a time, sometimes in small groups, they occur at the start of many flares, including small ones. Yet the speeds deduced are much higher—about one-third of the speed of light.

LETTERS TO THE EDITOR

THE FLUORESCENCE SPECTRA OF URANYL ACETATE SOLUTIONS

THE fluorescence spectrum of aqueous solution of uranyl acetate is reported to be continuous at room temperature, resolving at $-185°$ C. into a sequence of broad bands. With dilution in the ratio 1 : 160 a second series of bands appeared and at dilution 1 : 1600 both band sets vanished, giving room to a third sequence of very diffuse bands.[1,2] Our observations show that at room temperature the spectrum actually has some structure (Fig. 1 *a*) which improves on dilution (Fig. 1 *a'*). Addition of acetic acid reduces the intensity considerably (Fig. 1 *b*), while alkali increases the intensity (Fig. 1 *c*), although with further addition the spectrum becomes continuous and the intensity falls rapidly (Fig. 1 *d*). On standing overnight this solution regains in intensity, and the fluorescence spectrum is also different (Fig. 1 *d'*).

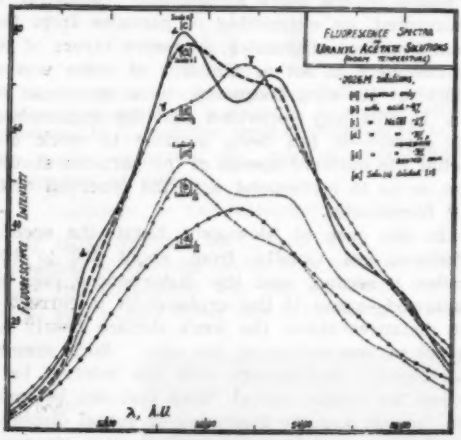

FIG. 1

To observe the variety of changes that take place in the spectra at liquid air temperature, titration with alkali or acid had to be followed in a large number of small steps. Only a few characteristic spectra are shown in Fig. (2 *a* to *f*). It will be seen that the bands marked α (Fig. 2 *a*) correspond to the diffuse maxima at room temperature and fall at 4930, 5145, 5385 and 5625 Å. The bands marked γ

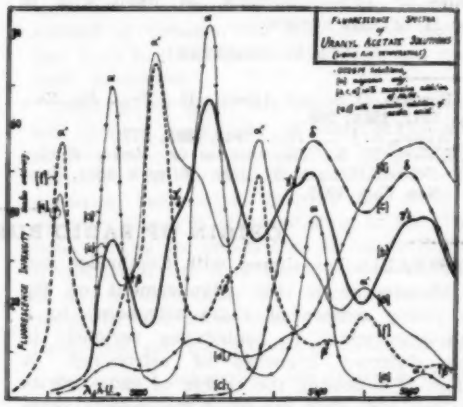

FIG. 2

(Fig. 2 *b*) form the second series and increase in intensity with increasing alkalinity. A sharp change then takes place when the third sequence bands, marked δ, replaces the first two (Fig. 2 *c*). With further addition of alkali these bands go on shifting continuously towards red (earlier stages not shown), and ultimately another change takes place, giving the spectrum (2 *d*). On the other hand with successive addition of acid to a solution that gives spectrum 2 *b* first the γ bands disappear (Fig. 2 *a*), and then the α bands are suppressed, giving place to a new set of distinct bands (marked α') located at 4825, 5030, 5260 and 5505 Å. (Fig. 2 *e*, *f*). In addition, a weak set of bands, marked β, also develops.

We express our thanks to the Scientific Research Committee, U.P., for financial assistance.

Dept. of Physics, D. D. PANT.
D.S.B. Govt. College, D. P. KHANDELWAL.
Naini Tal, *December* 5, 1957.

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THE PREPARATION OF URANIUM (IV) OXY-FORMATE

THE uranyl ion undergoes photoreduction when a solution of its formate is exposed to sunlight, uranium being precipitated as hydrated oxide. Advantage has been taken of the photolysis for the separation of uranium from sodium, calcium, lanthanum and cerium[1] in this laboratory. When a mixture containing equal volumes of saturated solution of uranium formate in water, formic acid and absolute alcohol is exposed to sunlight bright green crystals are formed. These bright green crystals were filtered, washed several times with absolute alcohol and dried in vacuum at the room temperature for 24 hours. The molecular weight was determined from the U_3O_8 obtained by heating weighed quantity of the compound in platinum crucible. Uranium content was determined by Jones reductor method.[2] The method adopted for estimation of formate content was to dissolve a weighed quantity in 6 N. H_2SO_4 and bringing about hydrolysis by adding NaOH solution in slight excess. After heating to boiling, the precipitate was filtered off and the filtrate was acidified with H_2SO_4. The estimation was carried out according to standard method[3] by making the filtrate again alkaline with solid Na_2CO_3. The data recorded in Tables I and II show that the bright green crystals are aquo-oxyformate having the formula $UO(HCO_2)_2$, $1{\cdot}5\,H_2O$. Since the compound is a new one, it was considered necessary to estimate the uranium content in the uranium (IV) state by the method adopted by Hatt[4] involving the precipitation of uranium (IV) as phosphate in hydrogen atmosphere followed by titration of the solution of the phosphate in H_2SO_4 against standard $KMnO_4$.

TABLE I

Mol. wt. (Theoretical) : 371·0

Mol. Formula : $UO(HCO_2)_2$, $1{\cdot}5\,H_2O$

Compound taken in g.	U_3O_8 found in g.	Mol. wt. computed	Compound taken	Estimation of U^{4+} by Hatt's Methods	
				Calculated	Found
0·2940	0·2215	372·3	0·1630	0·1032	0·1011
0·0962	0·0725	372·3	0·2805	0·1775	0·1728
0·1155	0·0871	372·0	0·2117	0·1354	0·1344
0·1550	0·1170	371·6	0·2256	0·1443	0·1420

TABLE II

Separate estimations of uranium and formate contents

Compound taken	U by J. reductor		Compound taken	Formate by alkaline $KMnO_4$	
	Calculated	Found		Calculated	Found
0·1791	0·1149	0·1141	0·1410	0·0342	0·0344
0·1516	0·0972	0·0973	0·1310	0·0318	0·0321
0·1783	0·1144	0·1141	0·1158	0·0281	0·0282
0·1658	0·1036	0·1039	0·1512	0·0367	0·0369

TABLE III

Compound taken	U_3O_8		Compound taken	U^{4+} by Hatt's Method	
	Calculated	Found		Calculated	Found
0·1495	0·1219	0·1209	0·2705	0·1871	0·1830
0·1368	0·1115	0·1106	0·2520	0·1743	0·1715

TABLE IV

Compound taken	U by J. reductor		Compound taken	Formate by $KMnO_4$	
	Calculated	Found		Calculated	Found
0·2361	0·1633	0·1629	0·2228	0·0583	0·0568
0·2629	0·1819	0·1813	0·2042	0·0534	0·0529

When the aquo-oxyformate was powdered and heated in vacuum at 160-70° C. for 4-6 hours, the anhydrous compound was obtained. The analysis was carried out as described above and the data obtained have been recorded in Tables III and IV.

The compound is insoluble in water and it undergoes slow hydrolysis which increases with the rise of temperature. The compound does not dissolve in solution of sodium formate. It is, however, soluble in acids. The thermal decomposition is proceeding.

Dept. of Chemistry, Ravenshaw College, Cuttack-3, *March* 5, 1958.

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UTILIZATION OF THE SOLUBILITY DATA FOR THE CALCULATION OF THE COMPOSITION, STABILITY AND FREE ENERGY OF FORMATION OF THE COMPLEX FORMED IN THE SYSTEM : AgCNS–NH_3–H_2O

THE direct method of calculation of the composition of complexes from solubility data as suggested by one of us,[1] has successfully been utilized by him to the systems : (i) KI-I_2-H_2O, (ii) KBr-Br_2-H_2O,[2] (iii) HCl-Cl_2H_2O,[3] (iv) AgCl-$Na_2S_2O_3$-H_2O,[4] (v) AgBr-$Na_2S_2O_3$-H_2O.[5] These calculations were extended by us to evaluate the formation constant and thermodynamic constants of several other complex forming systems as well.[6-9]

To test the validity of the calculations to other systems also, we have here studied the data of Garrick and Wilson[10] on the solubility of silver thiocyanate in aqueous ammonia, and have utilised their values for the calculation of composition, stability and free energy of formation of the complex species formed in solution.

The dissolution of silver thiocyanate in aqueous ammonia may be represented by the reaction :

$$AgCNS + nNH_3 \rightleftharpoons Ag(NH_3)_nCNS$$

If the solubility of AgCNS in water and aqueous ammonia of concentration c, be respectively a and b,

$[Complex] = (b-a)$
$[AgBr] = a$
$[NH_3]$ used $= n(b-a)$
$[NH_3]$ free $= c-n(b-a)$.

Formation constant

$$K = \frac{[Complex]}{[AgBr]\,[NH_3]^n}.$$

Taking two concentrations, a, a', b, b', and c, c' $(a = a')$,

$$K = \frac{(b-a)}{a\,(c-an+bn)^n} = \frac{(b'-a')}{a\,(c'-a'n+b'n)^n}.$$

Putting $s = (b-a)$ and $s' = (b'-a)$, we have,

$$\frac{s}{a\,(c-sn)^n} = \frac{s'}{a\,(c'-s'n)^n}$$

or

$$\frac{s}{s'} = \left[\frac{(c-sn)}{(c'-s'n)}\right]^n.$$

Taking logarithms of both sides we have,

$$\log s/s' = n\,[\log(c-sn) - \log(c'-s'n)].$$

Expanding the right-hand side in power series and neglecting the second and higher terms of the series, we finally have,

$$\log s/s' = n \log c/c'.$$

Therefore

$$n = \frac{\log s/s'}{\log c/c'} = \frac{\log (b-a)/(b'-a)}{\log c/c'}.$$

Since a is small in comparison to b, the expression becomes,

$$n = \frac{\log b/b'}{\log c/c'}.$$

From this expression, we have calculated the value of n, and as will be seen below, the value comes out to be unity. Hence for the calculation of K, the following expression has been used.

$$K = \frac{b}{a\,(c-b)}.$$

The free energy of formation ΔF° can be evaluated from the relation : $\Delta F^\circ = -RT$ in K, where R = gas constant, and T the absolute temperature.

Table I shows the values calculated by us from the data of Garrick and Wilson.[10]

TABLE I

Solubility of silver thiocyanate in aqueous ammonia

Concentration of ammonia gm.M/litre	Silver thiocyanate dissolved gm.M/litre	n	log K
1·026	0·00517	..	4·73
1·587	0·00854	1·1	4·74
1·840	0·01001	1·0	4·76
2·178	0·01234	1·0	4·76
2·276	0·01292	0·98	4·75
2·440	0·01376	0·97	4·65
		Average log K =	4·72

The results indicate the formation of $Ag(NH_3)CNS$, in a solution of silver thiocyanate in aqueous ammonia. The value of $\log K$ is 4·72, and that of $\Delta F°$ works out to be $-6·5$ K. cals, at 25° C.

The method described here is only applicable to associated complexes, *i.e.*, where *sn* is smaller than c in order to permit the higher terms of the series to be neglected.

Chemical Labs., ROSHAN LAL SETH.
University of Allahabad, ARUN K. DEY.
Allahabad, *March* 14, 1958.

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INITIATION OF POLYMERISATION OF METHYL METHACRYLATE IN AQUEOUS SOLUTION BY HYDRAZINE HYDRATE

N. URI[1] has stated that hydrazine in alkaline solution initiates the polymerisation of vinyl compounds.

It has been observed that hydrazine hydrate in aqueous solution initiates the polymerisation of methyl methacrylate at room temperature and even at 0° C. The reaction is characterised by a well-defined induction period, the length of which depends upon the concentrations of monomer and hydrazine, the pH of the medium and the type of distilled-water employed. Use of distilled-water of various types, like ordinary distilled-water, doubly distilled, and chemically pure water distilled over potassium permanganate resulted in the variation of the magnitude of the induction period under identical conditions of concentrations of monomer and initiator. The interaction of microconcentrations of organic impurities in distilled-water with free radicals in polymer reactions in aqueous solution has already been demonstrated[2] and our system perhaps provides another instance of such a phenomenon. In Table I are presented the data showing the variation of induction period and the degree of polymerisation of polymethyl methacrylate which was determined by viscosity measurements in benzene.

TABLE I

Temperature 25° C. (N_2H_4) *0·2 M* *(Monomer) 0·1 M*

pH	Induction period (in minutes)	Degree of Polymerisation
10	18	2820
9	22	2440
8	28	1980
7	35	1520

Even under conditions in which the oxygen from the reaction system was excluded by deaeration by oxygen-free nitrogen, initiation of polymerisation was observed. We have also investigated the reaction in the presence of varying amounts of hydroquinone. Not only was the induction period prolonged but the yield of polymer decreased with increasing

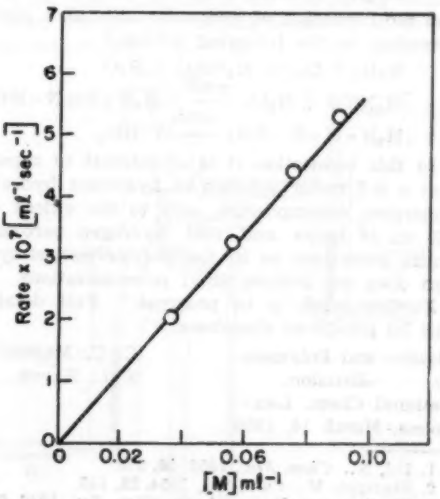

FIG. 1

concentration of hydroquinone, suggesting that the propagation process is a free radical reaction. However, Walling and Briggs[3] have concluded that hydroquinone does not retard the polymerisation of methyl methacrylate in the absence of peroxides and in our polymerisation system the possibility of formation of peroxide by the interaction of hydrazine with traces of oxygen in the system evidently exists.[4]

The rate of hydrazine disappearance which was followed by determining the hydrazine content of the system by Andrew's procedure was found to be independent of monomer

concentration for small conversions. At later stages of the reaction when the polymer formed is appreciable, the polymerisation is accompanied by gas evolution, leading to marked decrease in hydrazine concentration. The rate of monomer disappearance which was followed by finding the weight of the dried polymer, with 0·2 molar hydrazine concentration and at pH 10 was first order with respect to monomer concentration at 25° C. (Fig. 1). Both $\frac{-d(N_2H_4)}{dt}$ as well as $\frac{-d(M)}{dt}$ were of the order of 10^{-7} moles/litre/sec. It was also found that the reaction is not sensitized by radiation in the visible range.

In our preliminary experiments we could not identify the probable products of decomposition and oxidation of hydrazine like ammonia and hydrazoic acid. Ammonia can be formed in accordance with the following equation.[5]

$$3N_2H_4 \rightarrow 4NH_3 + N_2$$

and the formation of hydrazoic acid takes place according to the following scheme.[6]

$$N_2H_4 + O_2 \rightarrow H_2NNO + H_2O$$

$$H_2NNO + N_2H_4 \xrightarrow{-H_2O} H_2N-N=N-NH_2$$

$$H_2N-N=N-NH_2 \xrightarrow{-NH_3} HN_3.$$

In this connection it is of interest to report that a 0·2 molar solution of hydrazine hydrate undergoes decomposition only to the extent of 3% in 24 hours and that hydrogen peroxide under conditions as in the polymerisation system does not initiate vinyl polymerisations.

Further work is in progress. Full details will be published elsewhere.

Plastics and Polymers Division, National Chem. Lab., Poona, *March* 14, 1958.

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S. L. KAPUR.

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SPECTROPHOTOMETRIC METHOD FOR ESTIMATION OF CALCIUM IN SUGARCANE JUICES USING ETHYLENEDIAMINETETRAACETIC ACID

IN a previous communication, the authors[1] described a new spectrophotometric method for estimation of Ca^{++} in pure salt solutions, using ethylenediaminetetraacetic acid (EDTA). The principle of the method is that when a mixture of Ca^{++} and Cu^{++} in ammoniacal medium is titrated with EDTA, this last combines first with Ca^{++} and then with Cu^{++}, resulting in a decrease of the intensity of the colour (at $\lambda = 630\ m\mu$ characteristic of copper ammonium complex) only after the end-point of Ca^{++} (see Fig. 1). This method is now extended to the estimation of Ca^{++} in sugarcane juices.

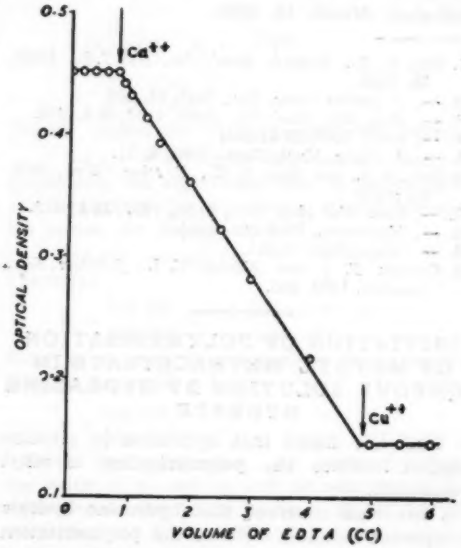

FIG. 1. Spectrophotometric titration of Ca^{++} with EDTA.

[The arrows indicate the end-points of Ca^{++} and Cu^{++} (see ref. 1); the end-point of Cu^{++} is of no interest for the present work.]

The existence of a certain amount of Ca^{++} in cane juices controls the clarification efficiency and the scaling problem; and the estimation of Ca^{++} in cane juice forms therefore one of the routine analyses, in a sugar factory. The method employed hitherto is the familiar oxalate method, which is indeed cumbersome and time-consuming. In the new spectrophotometric method, the cane juice of known specific gravity (or Brix) is treated with lead subacetate (familiar dry lead method adopted for polarisation experiments[2]) and filtered. The excess of lead in the *colourless* filtrate is precipitated by adding required quantity of solid $K_4Fe(CN)_6$ and filtered. One or two drops of conc. HNO_3 are added to the lead-free filtrate to convert the ferrocyanide to ferric-condition

such that Ca^{++} is not precipitated on long-standing (if required). To an aliquot of this solution is added ammoniacal $CuSO_4$ solution and titrated spectrophotometrically with EDTA solution, observing the changes in optical density at $\lambda = 630\ m\mu$ on a Unicam Spectrophotometer (D.G. 350; with optical column = 1 cm.).

Table I gives a typical set of data on the estimation of Ca^{++} in different samples of clarified cane juice. The results in column 4 refer

TABLE I

Estimation of calcium in sugarcane juices

Sample No.	BX of the Juice	Amount of CaO in gm. per litre of juice	
		Oxalate Method	Spectrophotometric Method*
1	17·50	1·0416	1·0413
2	16·76	1·1396	1·1375
3	16·38	1·1123	1·1025
4	15·28	1·1312	1·1200
5	17·67	1·2208	1·2075
6	16·59	0·9770	0·9888
7	18·25	1·1452	1·1288
8	16·91	1·2656	1·2425
9	17·43	1·1718	1·1725
10	15·37	1·1420	1·1375

* Concentration of Ca^{++} used—8 mM.
Do. Ammonia—2mM.
Do. EDTA—50 mM.

to the amount of Ca^{++} estimated by the oxalate method. It is seen that the data obtained by the spectrophotometric method agree closely (within ±0·5%) with those obtained by the oxalate method. It may be pointed out that while oxalate method requires 8-10 hr. time for completion of analysis, the spectrophotometric method requires 30-40 minutes.

Authors' thanks are due to Professor S. N. Gundu Rao, Director, National Sugar Institute, for his interest in the work; and to the Ministry of Education for a fellowship to one of us (R. K. C.).

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Kanpur, *March* 24, 1958. R. K. CHATURVEDI.

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TRANSFERENCE NUMBER IN BARIUM THIOCYANATE AND LEAD NITRATE BY A MOVING BOUNDARY TECHNIQUE

IT is now generally recognised that the conventional Hittorf method of determining transference number of an ion is not capable of the precision attainable with the E.M.F. and moving boundary method. Attempts have been made to modify Hittorf original apparatus[1-2] and to combine Hittorf type cell with moving boundary technique.[4] In testing the inter-ionic attraction theory and its practical applications to conductance, activity coefficient, liquid contact potential, diffusion coefficient, formation of complex ion, the determination of the transference number by the Hittorf analytical method has been largely replaced by the moving boundary system. The technique of observing a following boundary has also been improved.[5]

A convenient apparatus for measuring transference number by a falling boundary is shown diagrammatically in Fig. 1. The cathode

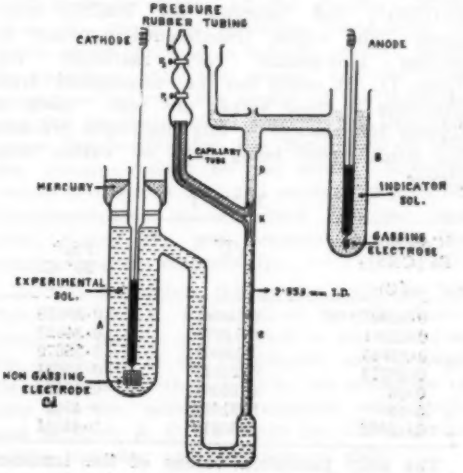

FIG. 1

chamber A and the measuring tube C were washed and filled with the experimental solution. The anode vessel B and the connecting tube D above the joint K were filled with a slower and lighter indicator solution. In this operation a small air bubble was enclosed at the joint K which was withdrawn by opening the pinch-cock P_1 and if necessary P_2 after completing the circuit and no mixing between the indicator and experimental solution thus took place. A constant current may be

maintained by hand regulation or by using a thermionic valve circuit.[6] The falling boundary was timed by means of a stop-watch.

Fig. 2 shows the region where Kohlrausch adjustment between an aqueous sol. of 0·1 N

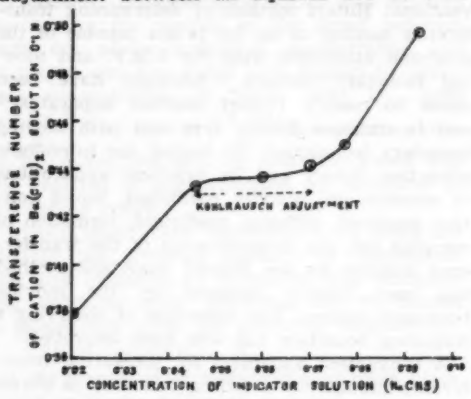

FIG. 2

$Ba(CNS)_2$ and indicator sol. NaCNS takes place. The cation transference numbers in barium thiocyanate vary markedly (*cf.* Table I). It could not be ascertained from literature if these values are real. Lack of further information on this electrolyte prevents too much stress being laid on cation complexes.

TABLE I

Concentration $Ba(CNS)_2$ (C)	$\sqrt{C}$	T_{Ba}^+ 25° C.
0·009973 N	0·09986	0·30550
0·01981	0·14075	0·34522
0·03945	0·19862	0·38670
0·06213	0·24928	0·40604
0·08	0·28284	0·42943
0·10	0·31623	0·4564
0·12903	0·35918	0·48181

The only published values of the transference numbers of lead nitrate are due to Falk.[7] These are only at two concentrations. Falk considered his results to be 3·2% lower, than those he probably expected. The agreement between the values obtained in this investigation and those found by Falk is, however, satisfactory (*cf.* Table II).

It is considered now that Falk's calculation was not correct but that his experimental values are correct. The limiting transference number value T°_+ at 25° C. for lead nitrate obtained from the published conductance measurements should be 0·4969 and not the value 0·503 adopted by Falk. According to this, the value of the limiting slope for lead nitrate required by the inter-ionic attraction theory is — 0·13152. This has been drawn in Fig. 3 as

TABLE II

Concentration $Pb(NO_3)_2$ (C)	$\sqrt{C}$	This investigation T_{Pb}^+ 25° C.	Falk T_{Pb} 25° C.
0·01 N	0·10000	0·48839	
0·025	0·15811	0·48823	..
0·02994	..	..	0·4874
0·05	0·22361	0·48766	..
0·10	0·31623	0·48766	..
0·1002	..	..	0·4875
0·15	0·38730	0·48724	..

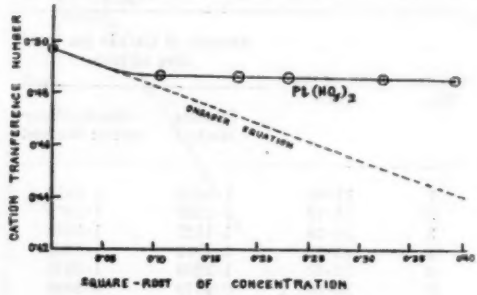

FIG. 3

dashed line. The experimental curve lies entirely above the limiting slope except at the extrapolated end points of the latter. As in this case it has also been observed in rare earth nitrates[8] that the transference numbers do not approach the Onsager limiting slope.

It may be assumed that lead nitrate is incompletely dissociated. On the other hand, the study of Raman effect[9] has shown that lead nitrate is completely dissociated even at high concentration. In general, the presence of complex cations will make the measured cation transference number too large, whereas complex anions will make it too small. If both are present in equal amounts the transference number would obviously remain constant with the change of concentration. This probably occurs with lead nitrate.

Dept. of Chemistry, J. N. SAHAY.
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ON THE TEMPERATURE AND SALINITY STRUCTURES OF THE BAY OF BENGAL

PREVIOUS reports on the vertical temperature structure,[1,2] and the thermal field at various depths,[3] of the Bay of Bengal along the East Coast of India are based on the bathy-thermographic data collected by the personnel of the Andhra University during the period October 1952 to April 1953. The author has more recently reported some semi-permanent thermal features[4] as revealed by the temperature structures constructed by him from the data collected during the period October 1955 to May 1956. A detailed investigation of the time and space variation of the temperature and salinity structures of the Western Bay of Bengal in general and the monthly mean conditions of the waters off Visakhapatnam in particular has been carried out by the author using both the data, the detailed account of which will be reported elsewhere. Some results of this investigation are briefly presented here.

TABLE I

Month	Means		Ranges of	
	Temp. °F.	Sal. ‰	Temp. °F.	Sal. ‰
October ..	84·0	19·85	83·3–86·2	17·06–23·21
November ..	80·7	23·87	81·5–78·5	24·20–23·44
December ..	79·0	28·23	77·5–79·7	26·00–28·49
January ..	78·7	32·84	77·2–79·0	32·74–33·13
February ..	80·0	32·76	79·3–80·9	32·56–33·38
March ..	80·7	33·50	80·0–81·7	34·24–33·08
April ..	82·8	33·87	80·2–85·6	34·34–33·63

Table I shows the monthly mean temperatures and salinities and their ranges for the surface waters over the continental shelf off Visakhapatnam. The sequence of changes in the thermal structure are as follows. The nearly isothermal nature (with slightly positive to slightly negative temperature gradients) of the surface layers upto the depth of the thermocline during October, develops into definite positive gradients of temperature and a subsurface zone of maximum temperature with the 'top-thermocline'[4] below it by November. The temperature gradients at greater depths would remain the same except for a slight change in the depth of the thermocline. These features would persist to some extent even during December. Convective mixing associated with the winter surface cooling during January and February results in a mixed layer of isothermal nature, eliminating the subsurface zone of maximum temperature, upto about 220′ below which the thermocline appears. During March and April the thermocline rises upto the very surface layers due to upwelling which starts by about the end of February along this coast. The seasonal heating in the surface layers results in negative gradients of temperature there and the thermocline gradually transforms into a top-thermocline during this period. At greater depths the isotherms will be closely packed due to intense upwelling taking place from deeper layers bringing up the colder waters. This investigation has further revealed that the month of the maximum intensity of upwelling is variable between April (as in 1953) to March (as in 1956) along this coast, though the period of upwelling generally extends upto May.

The salinity structures revealed that the salinity generally increases with depth in the surface layers during all the months. However, the depth of halocline (the layer in which sharp increase in salinity occurs) would be changing with the season and the close agreement between the depths of the halocline and the top-thermocline suggests that the processes responsible for the formation of both the features might be the same. Isohaline nature is observed over the continental shelf off Visakhapatnam below about 100 m. and 50 m. during the post-monsoon and the hot weather seasons respectively.

In this connection the author expresses his thanks to Dr. R. Ramanatham for his stimulating discussions and interest in the work; to his colleagues of the Geophysics and Zoology Departments for their help in the collection of data and the salinity estimations respectively and to Prof. E. C. La Fond for his guidance in the planning and collection of data.

Geophysics Dept., C. BALARAMA MURTY.
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BENEFICIAL EFFECT OF PROLONGATION OF THE WEANING PERIOD ON THE WEIGHTS OF RATS

THE young suckling rat is usually weaned from its mother on the 21st day. It is stated that even after this period it may still continue partially to depend upon its mother if allowed to suckle (Donaldson, 1924). In the absence of any published data it is not possible to indicate whether the prolongation of weaning time would have a beneficial effect on the growth of the young. This communication presents the results obtained in an investigation to elucidate this point.

Eighty healthy female albino rats who were nursing six young ones each were selected. They were made up of equal number of females nursing their first, second, third and fourth litters respectively. On the 21st day the total weight of young in each litter was recorded. These 80 litters were then equally distributed into two groups. Animals in group one were left with the mother for 4 days more while those in group two were separated. The distribution of the 80 litters in the two groups was carried out in such a way that in each group there were 10 litters from each of the four orders of birth with the same number of males and females. This was done so that the better growth capacity of males over females and also the animals from latter litters (Dikshit and Taskar, 1956, 1958) may not mask the beneficial effect of the extension of the weaning period. The average 21st day weights of the young animals in the two groups were the same, *viz.*, about 31·6 for males and 31·0 g. for females. The young animals in both the groups were fed on the stock diet *ad libitum* and they were weighed again on the 25th day. The weight increases in the two groups are represented in Table I.

The analysis of variance of these results is given in Table II.

TABLE II

*Analysis of variance**

	D.F.	Sum of Sq.	Mean Sq.	F	*t*
Presence of mother ..	1	530·71	530·71	77·7	8·81
Sex ..	1	2·92	2·92		
Mating ..	3	35·80	11·93		
Error ..	154	1052·29	6·83		
Total ..	159	1621·72	..		

*After correcting for individual differences in initial weights by analysis of covariance the value of *t* for presence (of mother) was found to be 8·87.

($t = 8·81$; D. F. = 154.)

Although both the groups had almost the same weight on the 21st day and were fed the same stock diet the animals in group one (who were permitted to be with their mothers for 4 days more) had greater weight gains in 4 days than those of group two. The increase in the weight of animals in the first group was fairly uniform, whereas that in the second group was somewhat variable.

The results in Tables I and II indicate that the young animals stand to benefit by the extension of the weaning period. The weight increase in the rats kept with mothers could only be due to extra nutrition that these animals obtained from the mother's milk and cannot possibly be attributed to any psychological effect of the proximity of the mother. This factor may play a very important role in the humans, but it is not known if this also operates in the rats. This observation is thus a pointer in favour of increasing or extending the weaning period. In this connection it may be worthwhile to note that Mendel and

TABLE I

Average gain in weight of young in 4 days

Order of litter series	Group I—Kept with mother for 4 more days after 21st day					Group II—Separated from mother after 21st day				
	No. of litters	MALES g.	MALES S.E.	FEMALES g.	FEMALES S.E.	No. of litters	MALES g.	MALES S.E.	FEMALES g.	FEMALES S.E.
I ..	10	9·04	0·68	8·78	0·83	10	6·18	1·01	5·92	0·63
II ..	10	9·18	0·99	9·61	0·78	10	5·77	0·80	5·49	0·80
III ..	10	9·29	0·77	8·33	0·51	10	4·24	1·05	4·44	0·97
IV ..	10	8·68	0·68	8·06	0·81	10	4·10	0·92	4·69	1·09

Hubbel (1935) had shown that the supplementation of a protein-rich "paste food" to the usual stock diet caused an increase in the weaning weight of young rats of Connecticut strain from 31 to 46 g. in males and from 30 to 47 g. in females during the period 1925 to 1935. The stock diet fed to our animals contains about 17% protein which as suggested by Goettsch (1948) should be optimal for rat growth. However, the supplementation of breast milk to this stock diet (the composition of which is given by Dikshit and Taskar, 1958) in the experiment for four more days beyond 21 days from birth is definitely conducive to better growth at weaning.

It is as yet not known if and how the higher weight at weaning time influences the subsequent growth rate. A follow-up study of the growth rate of the animals in the two groups was, unfortunately, not undertaken. It was, however, felt that such an information could also be obtained if the growth rates of rats having different weaning weights were studied. With this end in view male rats from 165 litters were selected and distributed into three groups. The weaning weights of animals in the three groups were in the range of 25·0 to 30·0 g.; 30·0 to 35·0 g. and 35·0 to 40·0 g. respectively. As shown in Fig. 1, the growth curve of the

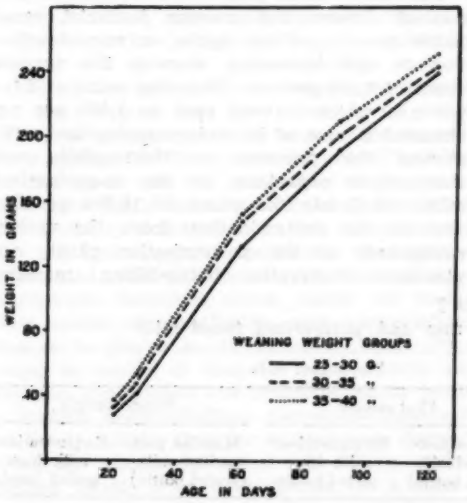

FIG. 1. Influence of weaning weight on the subsequent growth rate of albino rats.

heavier animals was consistently above that of the lighter ones. It is interesting to note that the weight differences existing at weaning time persisted till the adult stage. Thus the difference in the average weaning weight of animals in groups 1 and 3 was about 9·16 g. while the difference at 120 days was 10·12 g.

Grateful thanks are due to Dr. A. D. Taskar for expert assistance in the statistical analysis. It is a pleasure to thank Mr. S. Rajamanickam for his excellent technical assistance.

Nutrition Res. Labs., P. K. DIKSHIT.
I.C.M.R., Coonoor,
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VARIATION OF COMPRESSIONAL VELOCITIES IN INDIAN ROCKS AT LOW PRESSURES

IT has been suggested by earlier workers that at low pressures, the dilatational velocity increases with pressures at a considerable rate until it ceases to increase and begins to decrease slightly with pressure. The velocity increase in the low pressure region may be due partly to the finite compression of the specimen and partly to the vanishing of void spaces due to pressure. Compressional wave velocities have been measured and their variation studied in some Indian rocks, by the author, in the pressure region of the order of 4,000 lb./sq. inch. The experimental method used here is similar to that described by Tocher.[1] The travel times for longitudinal pulsed ultrasonic beam to travel over a given distance of the specimen are measured and the velocity computed. All measurements were made at room temperature and with no confining pressure other than that of the atmosphere. Velocities are measured in a direction parallel to the compression and they are found to increase with increasing pressure. Compressional velocities in Km./sec. at $P = 0$ ($V_{P=0}$) and $P = 4{,}000$ lb./sq. inch ($V_{P=4000}$) in a few Indian rocks, together with their localities, densities in g./c.c. (ρ), length (l) in cm., travel times in microseconds (μ_s) are given in Table I. The pressure noted in this table is not the one on the pump pressure gauge but is the one on the sample.

The results show that there is a considerable variation in the velocity even within the low

TABLE I

Rock	Locality	ρ	l	μ_s	$V_{p=0}$	$V_{p=4000}$
Granite ..	Hyderabad	2·66	9·50	15·15	6·26	6·31
Deccan trap ..	Ajanta	3·02	6·40	10·00	6·40	6·55
Charnokite ..	Pallavaram	2·75	5·15	8·45	6·11	6·20
Limestone ..	Shahbad	2·70	5·49	8·40	6·52	6·60
Sandstone ..	Orissa	2·12	7·19	17·40	4·10	4·40
Marble ..	Manditog	2·83	8·52	11·8	7·16	7·30

pressure region. The variation in sandstone is very appreciable and is as much as about 8%. This is to be attributed to the high porosity in comparison with the other rock types.

The author desires to express his grateful thanks to Professor Francis Birch for offering facilities in the Dunbar Laboratory, Harvard University, where this work was done and for his guidance.

Geology Dept., S. BALAKRISHNA.
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ON THE BACTERIOLOGICAL STUDY OF TONED MILK

AN investigation was carried out to study the standard plate counts of toned milk, raw and pasteurised by both laboratory and HTST methods at the Haringhata Farm. Samples of raw toned milk were taken from the bulk milk generally between 1 to 2 P.M. After the milk was pasteurised by HTST method at 170° F. for 30 seconds samples were taken from the sealed bottles. The first sample was taken between 2 to 3 P.M., and the second sample was taken between 3 to 4 P.M. as convenient. All the above samples were again pasteurised in the laboratory, re-pasteurisation being carried out from the sealed bottle. The test-tube method was followed in laboratory pasteurisation. Standard agar media was used for plating.[1] The plating was done in duplicate and the poured plates were incubated at 37° C. for 48 hours before the reading was taken. The investigation was carried out in March and April 1954.

RESULTS AND DISCUSSION

From the above figures, it was noted that the toned milk after laboratory pasteurisation showed the average bacterial count of 7,400 per c.c., which represented the thermoduric and thermophilic organisms present in the raw milk.

The same milk pasteurised by the HTST method showed the average bacterial count 18,200 per c.c., which again on re-pasteurisation in the laboratory showed the average count of 7,100 per c.c. Thus the count of 7,100 per c.c., which is very near to 7,400 per c.c. obtained in case of laboratory pasteurised milk, showed the presence of thermophilic and thermoduric organisms in the re-pasteurised milk. Obviously the count of 18,200 per c.c. was due to contamination from the various equipments of the pasteurisation plant, *e.g.*, pipelines, reservoirs, bottle-filling machine,

TABLE I

Results of bacteriological analysis of raw and pasteurised toned milk

Test	Raw toned milk	Pasteurised Milk				
		Laboratory pasteurised milk	First sample		Second sample	
			Machine pasteurised milk (sealed bottle)	Re-pasteurised milk from sealed bottle	Machine pasteurised milk (sealed bottle)	Re-pasteurised milk from sealed bottle
Standard Plate Count			Number of colonies per ml.			
Maximum ..	31,50,000	9,200	23,600	8 500	31,000	9,400
Minimum ..	8,50,000	3,300	15,000	3,000	19,000	3 400
Average of 30 samples	16,20,000	7,400	18,200	7,100	21,500	7,800

bottle, etc. The same thing was noted in the second sample. Another thing was seen in the second samples of pasteurised toned milk (sealed bottle) that they always showed higher counts than that of the previous ones, the possible cause of which might be due to accumulation of bacteria during the running of the plant, specially the bottle-filling machine.

*Dairy Farm, Haringhata, *February* 19, 1958. SATYA RANJAN SARKAR.

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* Present Address: Public Health Laboratory, Darjeeling.

A NOTE ON *GAFFKYA* SPECIES ISOLATED FROM INDIAN EARTHWORM

Bergey's Manual[2] provides key to only two species in the genus *Gaffkya* and refers the habitat of both as the animal body. The bacteria are pointed out to be parasitic, Gram positive and occurring as tetrads in the animal body and in special media only, while in ordinary culture media they are said to occur in pairs and irregular masses. The only other *Gaffkya* species described in the literature is also of animal origin and, in fact, has been reported to be pathogenic for the American lobster and as such named *Gaffkya homari*.[5] Thus all the three known species have animals as their habitat and are stated to be either white or greyish white in appearance on culture media.[1,2,5] The nomenclatural vicissitudes of the genus and the inadequacy of its definition have justly been the subject of a detailed discussion by Aaronson.[1] In this note is given, for the first time, the description of a yellow pigmented, aerobic, micrococcus isolated from earthworm intestines which, under the available system of classification and nomenclature, has to be placed in the genus *Gaffkya*. Perhaps, in course of time, if more strains are isolated and studied the organism would merit a specific name—*Gaffkya pheretima*—inasmuch as the 11 isolates thus far studied were derived from the alimentary canal of Indian earthworms, mostly *Pheretima* species. It is interesting to observe that even this species has as its habitat the animal body, though it is rather unfortunate that pathogenecity studies could not be carried out before a typical strain of this organism, maintained by us, was inadvertently lost.

It has been reported earlier[4] that of the 16 micrococci isolated from the intestinal contents of earthworms on nutrient agar, 4 were starch hydrolysing variants of *Micrococcus aurantiacus* and 1 *Micrococcus* sp. The remaining 11 were referred to as *Gaffkya* sp. as they were observed to be typical tetrads, even on ordinary media like nutrient agar. Details of the isolation procedures may be found elsewhere.[3,4] Relevant characteristics, which should prove to be of help in referring similar other isolates to this bacterium are presented in this note. It will be clear from the description afforded that the species under report differs substantially from other *Gaffkya* described so far and, perhaps, represents a new species.

Morphology: Typical tetracocci, 0·8–1·0 μ diameter; non-spore-forming; non-motile and non-capsulated; Gram positive.

Growth on Nutrient Agar: At 25-27° C. in 2 days, 1·5–2·0 mm. round, smooth, convex, entire, lemon-yellow colonies.

Nutrient Broth: Thin, pale yellow pellicle, yellow ring, heavy turbidity near surface and pale yellow to yellow, granular or viscid sediment.

Hydrogen Sulphide: Not formed; one strain formed H_2S after 8 days.

Indole: Not formed.

Nitrates: Not reduced.

Litmus Milk: No change.

Milk Agar: Casein slightly hydrolysed.

Gelatine: Liquefied.

Catalase: Present.

Ammonium Phosphate: Not utilised.

Sugar Media: Acid in maltose but not in lactose, glucose, sucrose, mannite, dextrin, starch and glycerine; one strain formed acid in dextrin also.

Microbiology Dept., St. Xavier's College, Bombay-1, *March* 17, 1958. S. R. KHAMBATA. J. V. BHAT.*

* Present Address: Fermentation Technology Laboratory, Indian Institute of Science, Bangalore 3.

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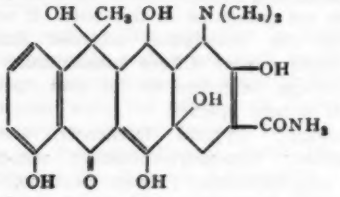
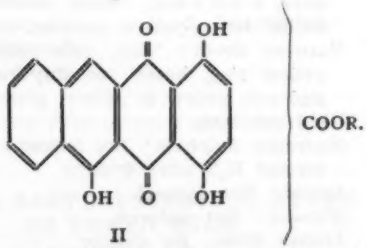
SYNTHESIS OF 7, 10-DIMETHOXY-5, 6, 11, 12-TETRAHYDRO NAPHTHACENE-6, 12-DIONE

RECENTLY a number of antibiotics[1] and quinones[2] have been isolated from mould metabolites which are hydronaphthacene derivatives. Terramycin (I) and related antibiotics are octahydronaphthacene derivatives while pyrromycinones (II) isolated by Brockmann from actinomycates are hydroxynaphthacene quinones.



I

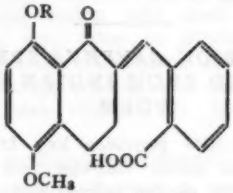


II

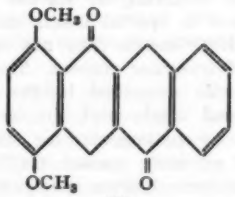
A few attempts have been made in the past to synthesise hydronaphthacenes by hydrogenating naphthacenes, naphthacene quinones[3] or using tetralin[4] as a starting material and building up the remaining part of the molecule. Very recent trend[5] is to build up molecules having chelating properties similar to tetracyclines. Gates and Dickenson[6] have recently reported the synthesis of a hydronaphthacene derivative. Older methods, however, are of limited application for the synthesis of substituted hydronaphthacenes and hence attempts are being made in this laboratory to develop new methods for their synthesis. The present communication records a preliminary investigation in this field.

5, 8-Dimethoxy-1-tetralone prepared by the modified method of Shah, Shah and Kulkarni[7] was condensed with orthophthalaldehydic acid to give 2-(2'-carboxy-benzylidene)-5, 8-dimethoxy-1-tetralone (III *a*); crystallized from alcohol, m.p. 166-67° C. (Found: C, 71·2; H, 5·1%. $C_{20}H_{18}O_5$ requires C, 71·0; H, 5·3%); 2, 4-dinitrophenyl hydrazone crystallized from acetic acid, m.p. 236° C. (Found: C, 59·9; H, 4·6; N, 11·1%. $C_{26}H_{22}N_4O_8$ requires C, 60·2; H, 4·3; N, 10·8%.) A mixed m.p. with the 2, 4-dinitrophenyl hydrazone described below showed no depression, thus showing that during hydrazone formation in presence of acid, lactonization also took place.

Attempts to cyclize (III *a*) to the corresponding 5, 6, 11, 12-tetrahydronaphthacene-6, 12-dione (IV) with concentrated sulphuric acid resulted in the formation of the lactone (V); crystallized from benzene, m.p. 156-57° C. (Found: C, 70·8; H, 5·4%. $C_{20}H_{18}O_5$ requires C, 71·0; H, 5·3%); 2, 4-dinitrophenyl hydrazone crystallized from acetic acid, m.p. 235-36° C. (Found: C, 60·0; H, 4·0; N, 10·5%. $C_{26}H_{22}N_4O_8$ requires C, 60·2; H, 4·3; N, 10·8%.)



III *a*; R=CH_3
III *b*; R=H

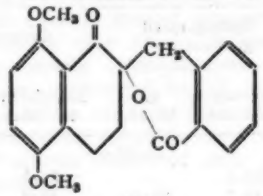


IV

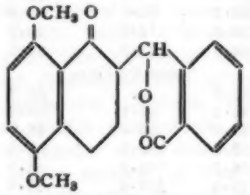
Cyclization of (III *a*) through the acid chloride with anhydrous aluminium chloride gave a tarry material. The new condensing reagent phosphorus oxychloride-zinc chloride so successfully used in the synthesis of xanthones by Shah[8] and co-workers gave 2-(2'-carboxybenzylidine)-5-methoxy-8-hydroxy-1-tetralone (III *b*); crystallized from alcohol, m.p. 145° C. (Found: C, 69·8; H, 5·2%. $C_{19}H_{16}O_5$ requires C, 70·3; H, 4·9%.) The acid (III *a*) was at last cyclized in very poor yields to the corresponding hydronaphthacene (IV) by polyphosphoric acid. The naphthacene derivative was isolated as bis-2, 4-dinitrophenyl hydrazone; crystallized from acetic acid, m.p. 230-31° C. (decomposition). (Found: C, 56·5; H, 3·7, N, 16·3%. $C_{32}H_{24}N_8O_{10}$ requires C, 56·5; H, 3·5; N, 16·5%.)

The structure of the lactone (V) is (V *a*) as on reduction with lithium aluminium hydride it gave a diol, without the carbonyl group or a double bond in conjugation with the benzene

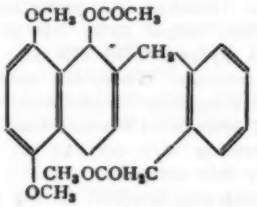
ring system, isolated as diacetate (VI); crystallized from alcohol, m.p. 191° C. (Found: C, 69·9; H, 6·5%. $C_{24}H_{26}O_6$ requires C, 70·1; H, 6·3% $\lambda^{alc.}_{max.}$ 292 mμ, log ε 3·696.)



V *a*

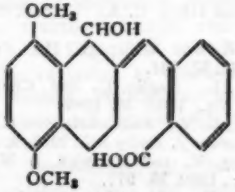


V *b*

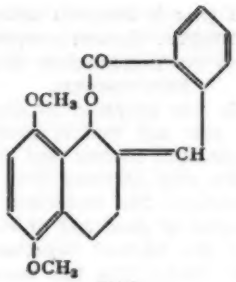


VI

Further the partial reduction of the carbonyl group of the benzylidene tetralone (III *a*), leaving the double bond in tact, for closing up the ring at 3-position of the tetralone, as was done by Sukh Dev[9] in case of Δ^3-octahydro-1-oxo-3-carbomethoxyazulene, was attempted by using sodium borohydride when 2-(2'-carboxybenzylidene)-5, 8-dimethoxy tetrahydronaphthalene-1-ol (VII) was formed. It was isolated as corresponding lactone (VIII); crystallized from alcohol, m.p. 151-52° C. (Found: C, 74·5; H, 5·8%. $C_{20}H_{18}O_4$ requires C, 74·5; H, 5·6%.) Attempts to enforce the conversion of this lactone[9] to the corresponding tetrahydronaphthacene, were fruitless.



VII



VIII

Experiments are in progress using hydroaromatic aldehydes and substituted tetralones. These and stereochemical investigation in this field would be reported elsewhere.

Chemistry Department, A. L. PANDIT.
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TOCOPHEROL CONTENT AS AN INDEX OF ADULTERATION OF GHEE

EMMERIE (1940), Lieck and Willsteadt (1945), Reinart (1949), Bird *et al.* (1951), Anglin *et al.* (1955), and Narayanan *et al.* (1956) have reported that the tocopherol content of butterfat lay between 10 μg./g. and 45 μg./g. of fat. Some other workers (Emmerie and Engel, 1943; Hove and Hove, 1945; Fisher, 1945; Ramamurthy and Banerjee, 1950) have analysed groundnut and sesame oils and reported a value as high as 200 μg./g. of fat. Mahon *et al.* (1955) have indicated that tocopherol estimation may prove useful in detecting adulteration of milk products like condensed milk, ice-cream and cheese. Information on the tocopherol content of Indian edible oils is scanty; estimation of

tocopherol in ghee is likely to indicate the extent of adulteration. Results obtained to check the hypothesis are presented in this article.

EXPERIMENTAL

Cream ghee was prepared by clarification of cream from cow and buffalo milk at 115° C. Coconut, groundnut, sesame and hydrogenated groundnut oils were obtained from the market in fresh condition. The tocopherol contents of a dozen samples of ghee and of each oil were estimated by the method reported by Narayanan *et al.* (1956). The fats were saponified with alcoholic potash in presence of pyrogallol and the unsaponifiable matter was dissolved in benzene (A.R., thiophene free). The carotene and vitamin A were removed by passing through a column of freshly activated floridin earth. The benzene filtrate was evaporated under reduced pressure and the residue dissolved in warm alcohol. Ferric chloride and α α, dipyridyl solutions in alcohol were added in succession and the red colour developed in 2 min. was measured colorimetrically. The results obtained are presented in Table I.

TABLE I

Tocopherol content of common edible oils

Fat	Tocopherol content μg /g. fat			Peroxide value ml 0·002N. Thio./g. fat
	Maximum	Minimum	Average	
Cow ghee ..	44·9	23·5	34·8	0·1
Buffalo ghee ..	36·7	18·0	25·9	0·1
Coconut oil ..	42·0	26·6	35·1	0·3
Hydrogenated groundnut oil	288·7	213·9	246·1	0·2
Sesame oil ..	290·9	199·2	241·5	0·5
Groundnut oil ..	330·6	228·6	255·9	0·6

Ghee was adulterated at 5, 10, 15, 20, and 25% levels with groundnut and hydrogenated groundnut oils and tocopherol contents of original ghee and adulterated mixtures estimated and the results are shown in Table II.

From Table I, the tocopherol content of ghee and coconut oil ranged between 20·6 μg./g. and 44·5 μg./g. of fat, whereas other vegetable oils showed much higher values (over 190 μg./g).

The tocopherol content of ghee increases with increasing admixture with extraneous vegetable fat (Table II). Five % adulteration increased the tocopherol value to as high as 45·7 μg./g. in cow ghee. A 10% addition to ghee caused an increase of nearly over 57% in cow ghee and 83% in buffalo ghee in the tocopherol contents. Addition of foreign fat to the extent of 20% to cow ghee and 15% to buffalo ghee almost doubled the tocopherol content. Of course, the natural variation of tocopherol content in ghee (20-45 μg./g.) limits the detection of adulteration below 10%. It is also noteworthy that hydrogenated oils also have high tocopherol contents. Where the analytical data of ghee are suspicious of adulteration, a determination of tocopherol content may prove useful. Adulteration with coconut oil will escape detection by this method.

TABLE II

Tocopherol content of adulterated ghee μg./g.

Adulteration %	Adulteration with: Hydrogenated groundnut oil		Adulteration with: Groundnut oil	
	Experimental value	% increase	Experimental value	% increase
	Cow Ghee			
0	35·5	..	35·5	..
5	45·7	28·7	45·6	28·4
10	56·0	57·7	56·7	59·7
15	66·2	86·5	65·9	85·6
20	76·3	114·9	76·2	114·8
25	86·5	143·6	86·5	143·6
	Buffalo Ghee			
0	28·6	..	25·6	..
5	36·2	41·4	36·0	40·6
10	47·0	83·6	46·9	83·2
15	57·6	125·0	57·5	124·6
20	68·2	166·4	68·1	166·0
25	79·0	208·6	78·8	207·8

The authors are thankful to the Director of Dairy Research for his keen interest in the work.

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Institute, Bangalore, *February* 10, 1958.

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FRUCTOSE-GLUCOSE RELATION DURING VEGETATIVE AND REPRODUCTIVE STAGES IN SUGARCANE

In an earlier communication[1] fructose was reported to exist in greater amounts than glucose in mature cane juices. In this note are presented certain characteristic trends in the relative concentrations of fructose and glucose in juices of early-flowering (Co. 285) and late-flowering (Co. 290) cane varieties recorded at specific stages of their growth and development.

Six to eight uniformly growing main shoots of similar physiological age were collected every time from each variety between 8-30 and 9-00 A.M. and juice extracted—sampling commencing from August 13, 1956, when the plants were six-months-old. Sucrose was estimated by the usual double polarisation method while fructose and glucose were determined according to the micro method of Van Der Plank[2] adopting the modification for the calculation of glucose in presence of fructose.[1] The errors due to sampling were so minimised that the magnitude of error between any two samples was never more than 3-5%.

In Table I are given the percentages (on juice weight basis) of fructose, glucose and sucrose in juices of the two cane varieties at specific stages of vegetative growth and flowering. The fructose/glucose ratios are given separately. In Fig. 1 is shown the general trend of the variation in fructose-glucose concentration during vegetative, symptom, short blade and arrowed stages of the two cane varieties.

In the early-flowering variety Co. 285 (Fig. 1 a, notched line) the fructose and glucose values increase rapidly during symptom and short blade stages (ascending arrow) and fall steeply during arrowing stage (descending arrow). Characteristically the F/G ratio (Fig. 1 b), shows the opposite trend. In the late-flowering variety Co. 290, the period of vegetative growth is prolonged and the rapid vegetative growth during this period is characterised by relatively high values in fructose and glucose with corresponding low values for F/G ratio. The trend of the fructose and glucose, and F/G values is similar as in Co. 285 during short blade and arrowing stages. In the early-flowering variety Co. 285, the rapid vegetative growth period is completed prior to the six months stage of the plants and hence the

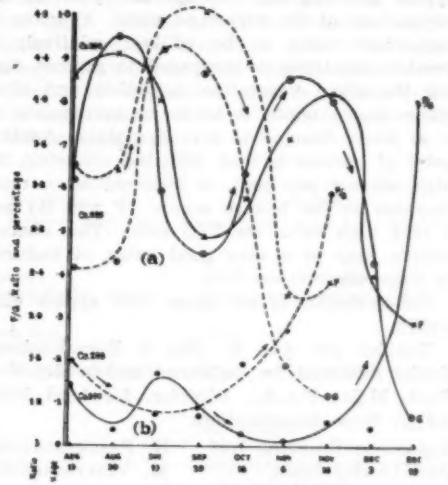

FIG. 1

TABLE I

Date of Sampling	Co. 285 (Early flowering) Stage at the time of sampling	Fructose (F)	Glucose (G)	F/G	Sucrose	Co. 290 (Late flowering) Stage at the time of sampling	Fructose (F)	Glucose (G)	F/G	Sucrose
1956	(Percentages on Juice-weight basis)									
13 August ..	Veg.	0·65	0·41	1·59	8·43	Veg.	0·85	0·61	1·39	6·20
30 August ..	Veg.	0·64	0·42	1·52	8·86	Veg.	0·91	0·95	0·96	7·43
19 September ..	Veg.	0·98	0·92	1·07	9·29	Veg.	0·80	0·59	1·36	9·96
30 September ..	Sym.	1·01	0·86	1·17	10·14	Veg.	0·48	0·44	1·09	10·33
18 October ..	S.B.	0·89	0·57	1·56	9·87	Veg.	0·57	0·63	0·90	9·40
6 November ..	Arrowed	0·35	0·19	1·84	13·21	Veg.	0·71	0·85	0·84	8·07
18 November ..	Arrowed	0·38	0·12	3·17	14·16	Veg.	0·81	0·80	1·01	7·11
3 December ..	..	..	..	..	..	Sym.	0·39	0·42	0·93	13·13
10 December ..	..	..	..	..	..	Arrowed	0·28	0·07	4·00	15·00

Veg. = Vegetative. Sym. = Symptom. S. B. = Short Blade.

high values in fructose and glucose as seen in Co. 290 are not evidenced.

Fructose values relative to glucose values appear to bring out an important point in the metabolism of the sugarcane plant. Fructose in sugarcane seems to be utilised relatively in greater quantities as compared to glucose during the rapid vegetative, initiation and short blade stages while it tends to accumulate or is in lesser demand at arrowing stage. Another point of interest is that, with the arrowing, the high sucrose per cent. is followed by a rapid decrease in the hexose sugars (F and G) and a very high value for F/G ratio. This characteristic may be a very good index of maturity in sugarcane.

Fuller details of the paper will appear elsewhere.

Thanks are due to Shri S. Ramakrishnan, Junior Assistant, for assistance, and to Shri N. L. Dutt, M.Sc., F.A.Sc., Director, for kind interest in these investigations.

Sugarcane Breeding Inst., K. PARTHASARATHI.
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A NEW BACTERIAL BLIGHT OF *CYAMOPSIS TETRAGONOLOBA* (L.) TAUB.

A DETAILED microscopic examination of a severe leaf-blight on *C. tetragonoloba*, found in August 1957, on the Agricultural College Farm, Anand, revealed yellow masses of bacteria oozing out from the affected leaf-tissues. The symptoms of the disease very much resemble those produced by *X. campestris*. The pathogen enters the leaf chiefly through hydathodes where it produces irregular, V-shaped pale-yellow spots of various sizes on the leaf-borders. The spots gradually increase in size when the central portion becomes pale-brown accompanied by a yellow water-soaked border. Under a severe attack, the entire leaf-border gets infected, the leaves shrivel, droop and die. Under ideal condition of infection as they occur under high humidity and low temperature (July-January), the infection becomes systemic as the pathogen migrates to the leaf-veins and makes its way as far as the stem through leaf-petiole. As a result, defoliation from the base upward is quite common. Lower leaves which are naturally shaded by the upper ones show heavier infection. Infection on the flower, the pod and the stem is not so far observed.

Morphology.—The organism is a short rod, single, rarely in pairs, gram-negative, not acid-fast, non-spore-former, capsulated, motile by a polar flagellum, yellowish and stains readily with common dyes. In 48-hour-old culture grown on potato dextrose agar at 27° C., the size of the cells is $1{\cdot}2\text{-}1{\cdot}5 \times 0{\cdot}4\text{-}0{\cdot}6\,\mu$.

Cultural and Physiological Characters.—On potato dextrose agar plates, the colonies are smooth, pulvinate, glistening with entire margins, consistency butyrous, 12 mm. in 6 days, striations from a central ring of about 3 mm., naphthalene yellow (Ridgway), border 0·5 mm. light-coloured; on slant, growth abundant, smooth, convex, glistening, butyrous, no striations, naphthalene yellow (Ridgway), border light-coloured, flowing; on cylinders, growth copious, flowing, shining, convex, covering the entire surface in 4 days, colour of the cylinder not changed, martius yellow (Ridgway), no odour, smooth filiform. On nutrient agar plates, colonies flat, poor in growth, smooth, glistening, with entire margins, straw colour (Ridgway), no striations, not butyrous, 6 mm. in 6 days, border 0·5 mm. light in colour; on slant, growth fair, flat, baryta yellow (Ridgway), entire slant not covered, filiform, no odour; in broth, very good growth within 24 hours, ring present, no floccules, no pellicle and no sediment; on dextrose plates, colonies smooth, convex, shining with entire margins, consistency butyrous, with striations, 9 mm. in 6 days, mustard yellow; on dextrose slant, excellent growth, flowing, filiform, no odour, entire surface covered, wax yellow; in dextrose broth, heavy growth within 24 hours, heavy ring, no floccules, no pellicle and no odour. Plain and litmus milk not affected; gelatin liquefied; starch and casein hydrolysed; H_2S produced; nitrates not reduced, NH_3 from nitrates or peptone not produced; indole not produced; Lœffler's blood serum liquefied in 4 days. Acid but no gas from dextrose, lactose, maltose, mannitol, glucose, xylose; no growth in salicin; alkaline reaction from acetic and citric acids; optimum growth at 25-27° C.; thermal death-point at about 51° C.; facultative anaerobe; sodium chloride tolerant upto 3%; pathogenic only to hairy and glabrous varieties of *C. tetragonoloba*.

Since no bacterial blight has been reported on *C. tetragonoloba* so far and since it does not infect other related plant species, it is proposed to name the pathogen *Xanthomonas cyamophagus* nov. sp.

Further details will be published elsewhere.

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Anand, *March* 1, 1958.

A NOTE ON HEPATIC FLORA OF MT. ABU

MT. ABU is the richest spot for vegetation in Rajasthan. It is situated between 24° 31'-24° 43' N. and 72° 38' to 72° 53' E. at an average height of about 4,200 ft. above the sea-level, its highest peak Gurishikar being 5,653 ft. above the sea-level. The rainfall is usually heavy, average being 61" to 65" annually and many shady types which are uncommon in neighbouring plains are met with here. The rainy season extends from about the month of June to middle of September during which liverworts and mosses are very common, occurring in different habitats.

Types		Localities	Habitat
ANTHOCEROTALES			
ANTHOCEROTACEÆ			
1. *Anthoceros himalayensis* Kash.	..	Very common	Moist and shady places
2. *Anthoceros erectus* Kash.	..	Behind Sirohi Kothi, Sunset point	Moist ground with mosses
3. *Phæoceros* sp.	..	Near Kodra dam	Moist soil
Notothylas Shull			
4. *Notothylas levieri* Schiff.	..	Kumarwara and Sunset point	Moist soil in patches
MARCHANTIALES			
Marchantia L.			
5. *Marchantia palymorpha* L.	..	Craigway	Moist Rock
Asterella Beauv.			
6. *Asterella angusta* St.	..	Very common	Dry and moist soil or rocks on bark of trees
7. *Asterella Blumeyana* Nees	..	Common	Moist ground and rocks
Plagiochasma L. et L.			
8. *Plagiochasma articulatum* Kash.	..	Very common	On moist soil, walls of old buildings
9. *Plagiochasma apendiculatum* L. et L.	..	Very common	Moist dry ground on walls, buildings, rocks and bark of trees
TARGIONACEÆ			
Cyathodium Kunge			
10. *Cyathodium tuberosum* Kash.	..	Very common	In moist and shady places usually in patches
11. *Cyathodium barodæ* Chavan.	..	Naki Lake, Achalgarh	On moist soil
Targionia (Mich.) L.			
12. *Targionia hypophylla* L.	..	Most common	On moist soil, rocks, walls of old houses, bark of trees
RICCIACEÆ			
Riccia (Mich.) L.			
13. *Riccia fluitanos* L.	..	Tank near Municipal Park	Banks of water where soil is very moist or actually under water
14. *Riccia hymalayensis* St. (*R. discolor* L. et L.)		Common	Moist soil and rocks
15. *Riccia frostrii* Aust.	..	Sunset point, behind Sirohi Kothi, Achalgarh	On banks of water
16. *Riccia crystallina* L.	..	Oriya, Kodradam Dilwara	Moist ground and rocks
17. *Riccia gangetica* Ahmad	..	Sunset point, Naki Lake, Achalgarh	Moist soil
18. *Riccia plana* Taylor	..	Anadhra point, Sunset point	Moist ground
19. *Riccia billardieri* Mont.	..	Kumarwara St. Mary High School	Moist soil and rocks
20. *Riccia aravalliensis**	..	Sunset point, Naki Lake	Moist ground
JUNGERMANNIALES			
ANACROGYNÆ			
ANEURACEÆ			
Metzgeria Raddi			
21. *Metzgeria himalayensis* Kash.	..	..	In moist places among mosses
CODONIACEÆ			
22. *Pellia epiphylla* Lindle.	..	Behind Sirohi Kothi, near Hanuman Temple, on way to Gaumukh	Near flowing water
23. *Calycularia crispulla* Mitt.	..	Hanuman Temple, Gaumukh	Moist soil
24. *Fossombronia himalayensis* Kash.	..	Sunset point	Moist soil with mosses

*While identifying some of my collections Dr. S. K. Pandé found it to be a new species. He has named it after Aravalli Hills.

Liverworts of Mt. Abu have received considerably little attention. Mahabalé and Chavan (1945) while describing Hepatics in Gujarat, and Mahabalé and Kharadi (1946), describing the ecological vegetation of Mt. Abu, mention (i) *Plagiochasma appendiculatum* L. & L., and (ii) *Riccia discolor* L. & L. The writer during his visits in different seasons to Abu has been able to collect following species of liverworts and various mosses from different localities. It is expected that many more may be found on further exploration of the vegetation of the place.

It will be seen from the above that the genera, particularly belonging to either Marchantales or Anthocerotales, like species of *Riccid, Fimbriaria, Targionia, Plagiochasma* and *Anthoceros* are widely distributed and found in various types of habitats.

The climate and edaphic factors favour the growth of liverworts but Abu often being dry for the greater part of the year, only those species are found here which can either resist the draught or can mature within a short period of 2 to 3 months. Probably Mt. Abu presents the Hepatic flora similar to that found in the hills of the Western or drier Himalayas. It is interesting to note that out of 24 species from Abu listed above, many are found in the Western Himalayas and South India. Hence Abu may be expected to present a hepatic vegetation intermediate between that of the Western Himalayas and South India and may form a connecting link between the two.

The author is highly grateful to Dr. P. N. Mehra for his valuable help and advice. I am also thankful to Mr. R. S. Chopra and Dr. S. K. Pandé for help in identifying some of the collections.

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Jodhpur, *February* 20, 1958.

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A NEW SPECIES OF *CERCOSPORA* ON *BLUMEA LACERA* DC.

IN connection with phytopathological survey of the areas commanded by Hirakud canal system, the common weed *Blumea lacera* DC. was observed to be heavily infected by a *Cercospora* sp. (Fig. 1). This particular fungus,

FIG. 1. Spots on the leaf of *Blumea lacera* DC.

descriptions of which are given below, is found to be very much different in character from *Cercospora blumeæ* de Thuemen,[2,5] recorded in India by Sydow and McRae (1929)[1,4] and *C. blumeæ-balsamiferæ* Sawada,[3] already reported on *Blumea* species.

Spots amphigenous, scattered, first appear as yellow specks but later turn brown and enlarge, 5 mm. (average 1 cm.) to 3 cm. in diameter, circular, often coalescent and irregular, older spots gray-coloured, central tissue necrotic, frequently become shot-holes.

Conidiophores very long, divergent, prostrate or curving down, straight or geniculate, thick-walled, brown-coloured, multiseptate with long internodes, fasciculate or in singles, protruding through stomatal openings, measure 103-(168·67)-426 $\mu \times 4\text{-}5\text{·}5\ \mu$; conidia hyaline, acicular, acropleurogenous, straight or arcuate, short septate, without oil globules, with hilum at the point of attachment, measure 56-(87·36)-144 $\mu \times 4\text{·}5\ \mu$ (Fig. 2).

Habitat: living leaves of *Blumea lacera* DC., 8-11-1956, Hirakud Island and Research Staff Colony premises, Sambalpur, Orissa, *Leg.* S. N. Das.

Type specimens deposited at the Herbarium of the New York State College of Agriculture, Cornell University; Herb. Crypt. Ind. Orient, I.A.R.I., New Delhi (25884) and at the Commonwealth Mycological Institute, Surrey, England (1. M.1. 67911).

Cercospora blumeicola Das, Spec. Nov.

Maculæ amphigenæ, dispersæ, primo apparentes ut puncta lutea, tandem evadentes brunneæ atque dilatatæ, diametientes 5 mm. (mediet. 1 cm.) ad 3 cm. circulares, sæpe coalescentes atque irregulares, maculis vetustioribus griseis, textu medio necrotico, sæpe evadentes cavæ.

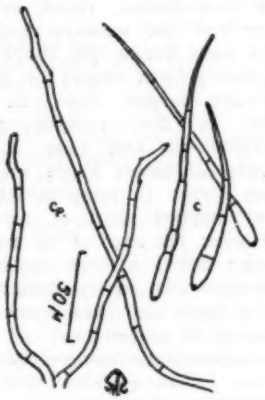

Fig. 2. Conidiophores (*Cp.*) and Conidia (*c*) of *C. blumeicola* Das.

Conidiophori longissimi, divergentes, prostrati vel deorsum curvati, recti vel geniculati, crassis parietibus præditi, brunnei, spatiis internodalibus longis, multiseptati, fasciculati vel singuli, emergentes per stomata, magnitudinis 103-(168·67)-426 µ × 4-5·5 µ; conidia hyalina, acicularia, acropleurogena, recta vel arcuata, breviter septata, absque globulis oleaceis, hilo ornata ad punctum junctionis, magnit. 56-(87·36)-144 µ × 4·5 µ.

Habitat in foliis viventibus Blumeæ laceræ DC. die 8 novembris anni 1956, in insula Hirakund atque in colonia ministrorum investigationis, ad Sambalpur, in Statu Orissa, legit S. N. Das.

Typus positus in herbario collegii Agriculturæ in Statu Neo-Eboracensi, in Universitate Cornelliana, in Herb. Crypt. Ind. Orient, I.A.R.I., New Delhi (25884) atque in Commonwealth Mycol. Instit. Surrey in Anglia (1. M.I. 67911).

In view of the divergent, very long conidiophores, hyaline acicular conidia and large gray spots, Dr. C. Chupp of Cornell University, U.S.A., and Mr. Deighton of Commonwealth Mycological Institute, England, considered this fungus to be a new species.

Thanks are due to Rev. Father Dr. H. Santapau, St. Xavier's College, Bombay, for rendering the Latin descriptions; to Dr. U. N. Mohanty, Deputy Director of Agriculture, Cuttack, for his helpful suggestions and to Shri G. N. Rout, Agricultural Research Officer, Sambalpur, for providing Laboratory facilities.

Section of Mycology, Agric. Res. Station, Sambalpur, *January* 13, 1958. Sitanath Das.

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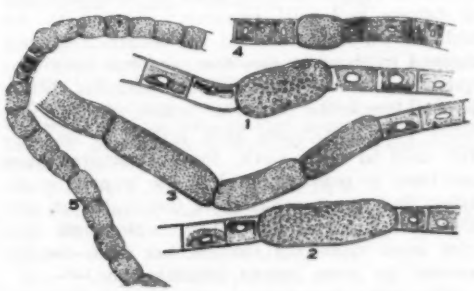
AKINETE FORMATION IN THE GENUS *HORMIDIUM* (KÜTZ.) KLEBS.

Two species of the genus *Hormidium*, namely, *Hormidium rivulare* Kütz. and *Hormidium subtile* (Kütz.) Heering, were collected in the vicinity of Nainital. *H. rivulare* was collected in October, 1957, from the exposed concrete footsteps near the Department of Botany and from the soil near the Library of Government College, Nainital, while *H. subtile* was collected in August, 1957, from shallow depressions on the surface of exposed rock. The materials were fixed in 4% formalin at the spot.

The specimens of both species were very interesting as they showed the formation of akinetes. In *H. rivulare* the akinetes were formed either singly (Figs. 1, 2) or in short



Figs. 1, 2. Filaments of *H. rivulare*, showing mature ellipsoidal akinetes, × 200.
Fig. 3. Filament of *H. rivulare*, showing young rectangular akinetes, × 200.
Fig. 4. Filament of *H. subtile*, showing solitary akinete, × 200.
Fig. 5. Filament of *H. subtile*, showing akinetes in a long chain, × 125.

chains of 4-5 (Fig. 3) in a filament. The spores were 3-6 times longer than the vegetative cells. Younger akinetes were rectangular in outline but at maturity they became ellipsoidal with or without a median depression. Mature akinetes were rich in oil content.

In *H. subtile* the akinetes were usually formed in long chains (Fig. 5) and in most cases nearly all the cells in a filament were transformed into akinetes. In a few cases they were formed singly (Fig. 4). Mature akinetes were usually rectangular but occasionally spherical ones were also met with. The akinetes were thick-walled and looked somewhat pale-green in colour. In some filaments there were colourless akinetes also.

The writer has not come across any description of akinete formation in the genus *Hormidium* except a brief reference in Fritsch (p. 206).[1]

To the best of writer's information this is the first record of akinete formation in genus *Hormidium*.

Dept. of Botany, K. P. SINGH.
Th. D. S. B. Govt. College,
Nainital, U.P.,
October 8, 1957.

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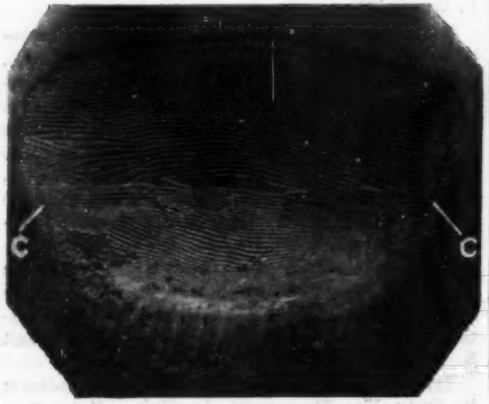
OCCURRENCE OF GROWTH CHECKS IN THE SCALES OF THE INDIAN MACKEREL, *RASTRELLIGER CANAGURTA* (CUVIER)*

AGE and growth studies form an essential part of fishery biological research. Owing to the well-known limitations of the length-frequency method in these studies the need has been frequently felt for other suitable methods. While in the temperate countries scales, otoliths and other bony structures have proved to be useful tools in such work, these structures have not been so readily useful in the tropical countries. But the possibility of the scales or otoliths being useful age-indicators in some species even in tropical waters has been demonstrated by some recent investigations.[1-9]

The great importance of searching for suitable age and growth indicators in the mackerel was stressed by the *Rastrelliger* Sub-Committee of the Indo-Pacific Fisheries Council at its Penang session in September 1956, in connection with the large-scale researches planned by most of the Indo-Pacific countries on this very important commercial fish of the region. It was therefore considered useful in this connection to examine the scales of the Indian mackerel (*Rastrelliger canagurta*) and a preliminary investigation on this aspect was taken up by the author in Karwar during the period October-December 1957. While this investigation is now being extended and more material from different parts of the Indian coast is still under examination, it is interesting to report here that the material collected from the Kanara coast during the above period has revealed clear growth checks or rings in the scales of the largest sizes, in the form of breaks in the sculpturing of the scales parallel to and near the margins. In practically all cases† there was only one ring in the scale; in some the upper sculptured layer stopped short of the lower unsculptured layer, the edge of the former marking the ring; but in a large majority of individuals there was a well-marked upper (sculptured) layer also outside the ring, often with a change of pattern.

The accompanying photomicrographs show scales of the Indian mackerel with and without the growth checks.

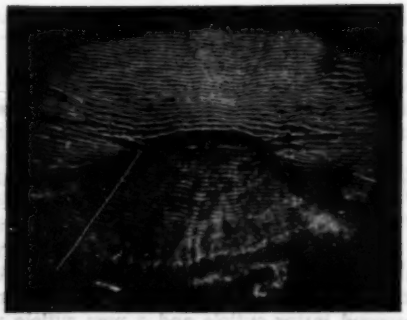


PHOTOMICROGRAPH 1. A scale of *Rastrelliger canagurta*. (Female. 24·6 cm. dated 20-11-1957), × 14·5. Mark C indicates the growth check.

Three hundred and sixty-nine individuals were examined in all from the North Kanara coast during the above period and the table shows the distribution of the scale rings in the different size-groups examined. It will be noted that rings were completely absent in all individuals below 22·0 cm. in all the three months while all individuals above 23·0 cm. showed clear rings. In the size-groups 22·1-

Months	Sizes (Total length in cm.)	Males		Females		Sex not known		Total	
		Nr. examined	Nr. with clear rings	Nr. examined	Nr. with clear rings	Nr. examined	Nr. with clear rings	Nr. examined	Nr. with clear rings
October	22·0 and below	8	0	9	0	11	0	28	0
	22·1 to 23·0	0	..	1	0	0	..	1	0
	23·1 to 27·0	11	11	15	15	0	..	26	26
	Total ..	19	11	25	15	11	0	55	26
November	22·0 and below	84	0	82	0	8	0	174	0
	22·1 to 23·0	4	1	5	1	2	0	11	2
	23·1 to 27·0	40	40	44	44	0	..	84	84
	Total ..	128	41	131	45	10	0	269	86
December	22·0 and below	16	0	10	0	7	0	33	0
	22·1 to 23·0	0	..	0	..	0	..	0	..
	23·1 to 27·0	4	4	8	8	0	..	12	12
	Total ..	20	4	18	8	7	0	45	12

23·0 cm., twelve specimens were examined; only two of these had clear rings in the scales. What may be described as false rings were occasionally noticed in all sizes but could be easily distinguished from the usual rings, the number of scales difficult to interpret being small. One is confronted here with a case of regular ring formation only in the larger sizes, the smaller sizes not showing rings although both groups have clearly passed through at least one monsoon. The rings are thus not comparable to the monsoon rings of *Cynoglossus semifasciatus*.[2-4]



PHOTOMICROGRAPH 2. A scale of *Rastrelliger canagurta* (Male, 20·7 cm. dated 20-11-1957). × 14·5.

Practically all the individuals with clear rings in the scales in the present work were adults in Stage I (or near Stage I) of maturity resting or recovering after a spawning. According to Pradhan[10] and the observations of other workers on the North Kanara coast (unpublished work at the Karwar Unit of the Central Marine Fisheries Research Station), the spawning season for the mackerel of that coast is generally from June to September; Pradhan[10] also states that the size of the mackerel at first maturity is 22·4 cm. Considering the above distribution of the scale rings in the different sizes in the light of these facts it seems very likely that the rings reported here are spawning marks occurring as a rule in the older individuals and may prove useful not only in age and maturity studies but also in raciation studies in view of the reported variation in the size-distribution and spawning period of the species in different parts of Indian coast.

Central Marine Fisheries Research Station, Mandapam Camp, *February* 27, 1958. G. SESHAPPA.

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• Three specimens measuring 25·0, 25·4 and 25·7 cm. had two rings in the scales near the margins in December but such cases are still to be studied in detail and are not classified here separately.

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THE SECOND INSTAR LARVAL CUTICLE OF *ATTACUS RICINI*

DURING the last two decades work on the insect cuticle has been carried out by several workers like Wigglesworth,[1,2] Wolfe[3,4] and others. It is now generally recognised that the insect cuticle consists of two fundamentally different layers, the epicuticle and the endocuticle. Histologically it appears as a uniform layer. However, recent histochemical methods show that it may consist of upto four definitive layers, an outer thin cement layer, a wax layer, a polyphenol layer and an inner cuticulin layer. All these four layers, however, may not be present in all the insects.

The present work was carried out on *Attacus ricini* (Lepidoptera). The histochemical tests described below were performed to determine the nature of the epicuticle. For histological investigations serial sections were taken from the time the larvæ hatched out of the egg. The sections were stained in Heidenhain's Azan, Mayer's Hæmalum and Eosin. Azan gave the best possible results. The larvæ were reared at 30° C. and 100% R.H.

HISTOCHEMICAL TESTS

The method followed was mainly devised by Wigglesworth (1948). The different processes in succession were: (*a*) killing the larvæ in ammonia vapour, (*b*) treating the larvæ for 1 hr. in cold chloroform, (*c*) boiling the larva in chloroform for 1 hr., and (*d*) immersing the larva treated under (*b*) and (*c*) in ammoniacal silver nitrate solution. A control test was run.

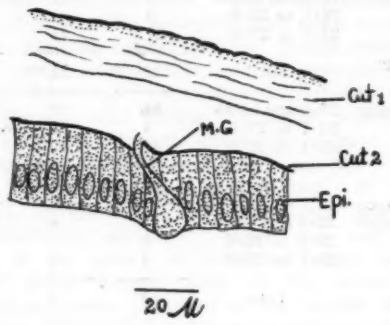
To determine the presence of cuticulin layer the tergum was boiled in 10% potassium hydroxide solution to dissolve the endocuticle and polyphenol layers.

RESULTS OF HISTOCHEMICAL TESTS

Larvæ, whether treated in cold or boiling chloroform, gave Argentaffin reaction on treatment with ammoniacal silver nitrate solution. This clearly showed that the outermost cement layer is absent. The darkening is due to the presence of a polyphenol layer. The control test larva failed to show any darkening of the surface. We can thus infer from it that the outermost layer of the epicuticle is the wax layer. The caustic potash test showed the presence of cuticulin layer as the innermost layer of the epicuticle. Thus the epicuticle of the second instar larva of *Attacus ricini* is composed of the wax layer, the polyphenol layer and the cuticulin layer. The cement layer is absent.

RESULTS OF HISTOLOGICAL OBSERVATIONS

The epidermis separated from the first instar larval cuticle on the seventh day showed in the intervening period intense activity which was characterised by the epidermis becoming elongated and granular (Text-Fig. 1). At this stage



TEXT-FIG. 1. Camera lucida drawing of the epidermis on seventh day stage.

Cut. 1. Cuticle of the first instar; Cut. 2. Cuticle of the second instar; Epi. Epidermis; M.G Moulting gland

moulting glands were observed. Multicellular trichogen cells and œnocytes were also observed at places. Besides these, pore canals were observed extending upto the epicuticle. On the ninth day most of the endocuticle of the larval cuticle was found to have been digested and the moulting of the first larval cuticle took place. By this time the second larval cuticle was not completely formed. By the eleventh day the second cuticle attained its maximum size and on the twelfth day the condition was similar to the eleventh day stage. On the thirteenth day the epidermis separated from the second instar cuticle and a new cuticle was deposited in its place. The second instar larval cuticle has an exocuticle which appears dark brown with Azan, the endocuticle, on the other hand, appears blue with this stain.

Further investigation is in progress and a detailed paper is expected to be published shortly by us.

Dept. of Zoology, R. K. SHARAN.
Science College, S. L. SAHNI.
Patna, *March* 14, 1958.

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3. Wolfe, L. S., *Q.J.M.S.*, 1954, **95**, 67.
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OCCURRENCE OF *ANCHOVIELLA INSULARIS* HARDENBERG OFF WALTAIR COAST

HARDENBERG[1] first reported *Stolephorus* (*Anchoviella*) *insularis* from the Indonesian waters. His identification is based on vertebral counts, the length at which maturity is first reached, and on investigations of planktonic eggs by Delsman.[2] Later, Fowler[3] described the same species as *A. bataviensis*. Hardenberg divided the species into four subspecies based on vertebral counts and other external characters.

In our studies on *Anchoviella* spp. of the Waltair coast, we have come across, in addition to *A. heterolobus*, *A. indica* and *A. commersonii*, a large number of forms which fit into the description of *A. insularis* given by Hardenberg and Fowler.

The following are the characters of the species under study:

1. There are three main groups with regard to the number of vertebræ. Of the 416 specimens examined from 10 samples, the distribution was as follows:

No. of vertebræ	No. of specimens
38	19
39	180
40	65
41	148
42	4

Our observations show that the two small groups with 38 and 42 vertebræ occur especially when the forms with 39 and 41 vertebræ are predominant in the catches, and hence are to be included among them respectively.

2. A count of rays in the left pectoral fin of 331 specimens gave the following results:—

No. of Pectoral fin rays	No. of specimens
11	27
12	110
13	140
14	52
15	2

3. An examination of 261 specimens for the number of gill rakers on the longer arm of the first gill arch of the left side, shows the distribution as follows:

No. of gill rakers	No. of specimens
19	34
20	89
21	85
22	45
23	8

4. The ovarial eggs are oval with a knob at one end, resembling those of *Stolephorus* (*Anchoviella*) *insularis*, described by Delsman.[2]

5. Dense pigmentation on the head and upper half of eyes, especially in the larger forms, but without any definite pigment lines on the back.

The only other species of *Anchoviella* which could be confused with *A. insularis* are *A. commersonii* and *A. tri*. But the characters of the species obtained by us do not agree with those of the latter two species as given by Hardenberg[1] and by Nair.[4]

1. Characters in which *A. insularis* differs from *A. commersonii*:

A. commersonii	*A. insularis*
1. Two pigment lines on the back from head to dorsal fin.	Absence of these pigment lines.
2. No dense pigmentation on the upper half of eye.	Dense pigmentation on the upper half of eye.
3. The mean of the number of rays in the left pectoral fin is 14·24.	The mean of number of rays in the left pectoral fin is 12·67.
4. The number of gill rakers ranges from 22–24.	The number of gill rakers ranges from 19–23.
5. Anal fin starts below about the posterior ⅓ of dorsal fin.	The anal fin starts below the middle of dorsal fin.
6. The ovarial eggs are shorter and wider with a prominent knob.	The ovarial eggs are longer and narrower with a less prominent knob.

2. Characters which distinguish *A. insularis* from *A. tri*:

A. tri	*A. insularis*
1. Presence of pigment lines from head to caudal fin.	Absence of these pigment lines.
2. The oval eggs are not knobbed.	The oval eggs are knobbed.
3. The anal fin starts below posterior ¼ of dorsal fin.	The anal fin starts approximately below half the dorsal.
4. The number of vertebræ is 38.[1]	The number of vertebræ is more than 38.

This is the first report of the occurrence of this species in Indian waters. Present data indicate the presence of at least two subspecies. Further work is in progress, and details will be published elsewhere.

Dept. of Zoology, S. DUTT.
Andhra University, M. BABU RAO.
Waltair, *February* 14, 1958.

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4. Nair, R. V., *Jour. Zool. Soc. India*, 1953, 5 (1).

NOTE ON THE PROTEINS FROM THE SEEDS OF *SESBANIA GRANDIFLORA*

THIS note deals with protein adhesives made from the seeds of *Sesbania grandiflora* which have been reported rich in proteins (Subrahmanyan *et al.*, 1952).

The seeds, obtained from the Director of Agriculture, Madras, had the following proximate composition: moisture 6·5%, nitrogen 6·9%, fat 7·6% and ash 4·3%. Extraction with various solvents resulted in the following percentages of the total nitrogen being removed: water 46·9, 4·0% sodium chloride solution, 55·4, 80% alcohol 9·0, 0·4% sodium hydroxide 82·6 and 0·4% sodium sulphite 78·0.

For the preparation of the protein, 20 g. of the defatted meal were extracted thrice with sodium sulphite, centrifuged and the protein precipitated from the clear extract with acetic acid. The yield was 32% with sodium sulphite and slightly higher at 35% with sodium hydroxide. The defatted protein gave: moisture 7·2%, nitrogen 13·85% and ash 7·6%. Washing reduced the ash content to 3·2%.

Adhesives were made from this protein using borax formaldehyde or furfural formulations. (Narayanamurti and Kartar Singh, 1942). Plywood made with such glues gave, on testing, the following results (Table I).

The defatted flour when used as a filler in casein glues (2 : 3) using the lime fluoride formula (Narayanamurti *et al.*, 1943) gave the following results.

TABLE II

Glue adhesion			
Dry		Hot wet 70° C.	
F.L. Kg.	G.F. %	F.L. Kg.	G.F.
100·24	40	43·54	100

Forest Research Inst., D. NARAYANAMURTI.
Dehra Dun, R. C. KOHLI.
March 26, 1958.

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2. Narayanamurti, D., *et al.*, *For. Bulletin*, 1943, No. 116.
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TABLE I

	Glue Adhesion strength							
	Formaldehyde				Furfural			
	Dry		Hot wet 100° C.		Dry		Hot wet 100° C.	
	F.L.+ Kg.	G.F.* %	F.L. Kg.	G.F. %	F.L. Kg.	G.F. %	F.L. Kg.	G.F. %
Protein from whole meal ..	127·00	50	79·83	100	128·82	80	53·54	100
Protein from defatted meal ..	81·64	100	48·99	100	128·82	70	61·69	100

+ F.L. = Failing load. * G.F. = Glue failure.

A CHEMICAL EXAMINATION OF *EMBLICA OFFICINALIS*, GAERTN

THE fruit of *Emblica officinalis*, Gaertn, formerly *Phyllanthus emblica*, Willd (*Hindi and Bengali*: Amla, *Malayalam and Tamil*: Nellikkai) is one of the most used and reputed drugs in indigenous Indian medicine. It is refrigerant, diuretic, laxative, alterative, rejuvenant and good for diabetes.[1,2]

It is one of the richest and cheapest sources for vitamin C, the quantity of which does not appreciably diminish when stored dry.[3-6] Recently Dhar *et al.*[7] made a paper chromatographic study of its extracts.

Results Obtained

The dry powdered pericarp of *Amla* contains fatty matter (about 6%), gallic acid (5%), a new crystalline acid phyllemblic acid, $C_{16}H_{28}O_{17}$ $(COOH)_8$, m.p. 222-24° C. (6·3%), a new crystalline phenolic product, emblicol, $C_{20}H_{30}O_{19}$ $(OCH_3)_6$, m.p. 191-94° C., ellagic acid and other products. Some appear to be products of hydrolytic fission as the juice of the fresh fruit contains much less gallic acid.

Means and Methods

The pericarp was first dried in the sun and then at 50° C. and 100 mm. pressure. Only two out of several methods tried are described in this paper.

Extraction I.—The powdered pericarp (100 g.) was extracted with water (1½ litres), pressed in a linen bag, filtered and the brown filtrate (900 ml.) extracted for 18 hr. with ether in a liquid-liquid extractor. The crystalline ethereal residue (5 g.) on purification gave gallic acid, m.p. 250-53° C., identified by analysis and mixed melting point.

A New Acid Phyllemblic Acid (6·3%).—After extraction with water the press-cake was extracted with caustic soda to pH 8 (2%, 350 ml.), the slimy product pressed through linen and centrifuged. The clear brown liquid (342 ml.) was acidified (HCl, 20% to Congo-red), cooled, filtered, the residue washed and dried; (micro-crystalline powder, 6·3 g.), m.p. 219-22° C. This new acid was insoluble in all common solvents and was purified by repeated crystallisation of the ammonium salt from aqueous ammonia (charcoal), or by treatment with a solution of sodium bicarbonate, when the acid dissolves and the sparingly soluble sodium salt crystallises out, the acid being regained by acidification. Two such treatments gave a pure ash-free product, white rectangular plates, m.p. 222-24° C. There was no loss in weight when dried at 110° C. *in vacuo* over P_2O_5. It gave no coloration with ferric chloride. Found: C, 33·78, 34·25; H, 4·58, 5·19%; Eq. wt. 106·9 (NaOH), 105·55 (Ag salt). $C_{16}H_{28}O_{17}$ $(COOH)_8$ requires: C, 33·80; H, 4·23; minimum mol. wt. 852, i.e., (106·5 × 8).

Phyllemblic acid has first the sour-bitter and then the sweet astringent taste associated with *Amla*.

Extraction II.—The powdered pericarp (1,828 g.) was soxhleted, first with dry ether for 20 hr. (150 g. fatty and other matter) and then with (frequent changes of) methanol for four months. Thick brown easily soluble products were obtained in the first three days, after which almost insoluble solids (A) began to separate. The solids A (68·9 g., 3·8%) were filtered off, concentration of the mother liquors gave soluble crystalline material B (125 g., 6·8%), softening from 170° C. and melting before 184° C.

Insoluble Product A.—The insoluble product A (0·8 g., ash 9%) was subjected to chromatography by the method of 'divided columns'.[8] Mercks alumina (40 g., 45 cm. high) was used, the substance was eluted with pure methanol, then with methanol containing 1% acetic acid, and later with methanol containing 1% HCl. Twenty fractions (50 ml. each) were collected. The second eluant gave a microcrystalline powder which does not melt up to 400° C. and the third eluant gave pale yellow crystals of ellagic acid (0·1 g.).

Emblicol, a Phenolic Substance (Ca 4·5%).—The soluble solids B gave by repeated crystallisation from methanol, a more soluble phenolic acid and a less soluble phenol, emblicol, crystallisable from methanol or ethanol, thin rectangular plates, m.p. 191-94° C. It is insoluble in ether and benzene, fairly soluble in water and the simple alcohols, does not give carboxylic reactions and gives a faint blue colour with ferric chloride.

Found: C, 40·78; H, 6·22; (OCH_3) 23·7, 25·3%. $C_{20}H_{30}O_{19}$ $(OCH_3)_6$ requires: C, 41·06; H, 6·32; $(OCH_3)_6$, 24·47%.

Emblicol has the lingering sweet astringent taste of the drug.

Acknowledgement

The analyses were kindly carried out in the National Chemical Laboratories, Poona. One of us (K. M. I.) thanks the Government of India for a Senior Research Scholarship.

Applied Chemistry Dept., P. P. Pillay.
University of Kerala, K. Mahadeva Iyer.
February 21, 1958.

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CYTOPLASMIC MALE STERILITY IN PSYLLIUM (*PLANTAGO OVATA* FORSK.)

CYTOPLASMIC male sterility has been reported[1] in flax, onions, carrots, sugar beets, corn, and sorghum, and a few other plants used mainly for genetic investigation, such as *Epilobium* and *Oenothera*. Very little is known about the occurrence of cytoplasmic male sterility in the lesser important economic crops and non-commercial plants. This type of male sterility is a valuable tool in the hands of plant breeders and hybrid seed producers, since a normal plant can be made male sterile by crossing with the cytoplasmically male sterile plants as the recurrent female parent.

Plantago ovata Forsk. is the source of Psyllium or Isabgol seeds and is cultivated extensively in northern parts of Bombay State and is a major article of export to the United States.[2] During the course of a study of the mucilaginous seeds it was found that a fair proportion of the plants of *P. ovata*, both under cultivation and in the wild state, showed a male sterile condition. Such plants could be readily differentiated from the normal plants by the shrivelled appearance of their anthers as compared to the membranous, well developed anthers of the normal plants. On microscopical examination, the shrivelled anthers were found to contain no pollen grains in the pollen sacs. However, no difference in the seed setting quality of both normal and male sterile plants could be observed, both being freely wind-pollinated and perfectly female fertile.

In order to determine the type of male sterility the seeds were collected separately from six normal and six male sterile plants. Their progeny was followed for three generations and the results are discussed below.

1. All normal plants, whether selfed or cross-pollinated, gave normal plants at each successive generation. The only exception was the occurrence of a few partially sterile plants when grown under greenhouse conditions. Jones and Mangelsdorf[3] observed a similar appearance of male sterility in normal corn plants grown in the greenhouse and attributed it to the effect of a higher temperature at the seedling stage.

2. All male sterile plants used as female parent when crossed with male fertile plants gave male sterile plants. This purely maternal transference of male sterility appears, therefore, to be due to the effect of the cytoplasm. From the limited number of normal plants used in this study, there appeared to be no evidence of any fertility restorer genes.

It is of interest to mention here that male sterility has also been observed by the writer in the common weed, *Pantago lanceolata* L., growing at several different localities. No attempts have, however, been made to determine the type of sterility in this case. Further work is in progress.

My sincere thanks are due to Prof. P. N. Mehra for helpful suggestions.

Dept. of Pharmacognosy, C. K. ATAL.
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MICROTRON

A MACHINE of novel type for the acceleration of electrons to high energies has been completed and brought into use at University College, London, by Dr. Aitken and Dr. R. E. Jennings. It overcomes in an unusual way a difficulty in design caused by the increase in mass of the electrons as the speed of light is approached.

The trick used in the University College machine is to arrange that the extra energy given to the electrons at each circuit is such that their mass is increased in steps, each equal to the mass of an electron when at rest. Under these conditions the times taken in successive circuits increase progressively, but are in all cases an exact multiple of the time taken for the first circuit. The electrical pulse that provide acceleration can therefore be applied at regular intervals and, although some pulses will be missed, there will always be a pulse when it is wanted.

The principle of this type of accelerator was originated by three Canadians—Dr. J. T. Henderson, P. A. Redhead, and H. Le Caine—working for the Canadian National Research Council. It is called the "Microtron" because the electrical pulses used in acceleration are got from a pulsed microwave oscillator.

The University College machine accelerates electrons to an energy of 29 million electron volts and is the largest yet built.

REVIEWS

Fundamental Constants of Physics. By E. R. Cohen, K. M. Crowe and J. W. M. Dumond. (*Interscience Monographs*, Vol. I), 1957. Pp. xi + 287. Price $7.50.

The last twenty-five years have contributed greatly to the improvement of our knowledge of the constants of physics, through the use of new precision techniques and methods of measurements, combined with advances in our understanding of atomic and nuclear physics. This book is a competent survey of this development in our knowledge of the fundamental constants and conversion factors of the physical sciences. Most of the earlier and less precise experiments have been reviewed rather briefly, one of the authors' objective being, "to present an account of the evolution of our knowledge of this subject through various degrees of experimental precision and theoretical sophistication in sufficient detail to permit the reader to appreciate the breadth and firmness of the entire experimental foundation". This objective has been substantially achieved.

After one introductory chapter, there is one chapter devoted to arbitrarily defined physical units and standards like those of length, mass, volume, time, temperature and electrical units and another chapter devoted to classical measured constants and units like universal gravitation constant, gas constant, Joule equivalent, etc. Coming to recent developments, there is one chapter on masses of atoms and mesons, masses and properties of light mesons, K-mesons and of hyperons. One wonders, at this stage, why experiments on the properties of other fundamental particles like the positron and the neutrino have not been included in the subject-matter of the book. One chapter deals with the history of atomic constants like velocity of light, electronic charge e, the X-unit, Avogadro's number and Planck's constant. Another chapter describes the post-war high-precision measurements of constants like gyromagnetic ratio of the proton, ratio of electron magnetic moment to proton magnetic moment and hyperfine structure shift in hydrogen. There are two very useful chapters on the method of least squares and its application in the determination of atomic constants.

The book is undoubtedly a very helpful reference work for physics students and for teachers and research workers in physics.

B. V. THOSAR.

High Energy Nuclear Physics. (*Proceedings of the Seventh Annual Rochester Conference*, April 15-19, 1957.) Compiled and edited by G. Ascoli, G. Feldman, L. J. Koester, Jr., R. Newton, W. Riesenfeld, M. Ross, R. G. Sachs. Distributed by Interscience Publishers, Inc., 250, Fifth Avenue, New York City. Pp. ix + 473. Price $4.50.

This volume is a report of the Proceedings of the Seventh Annual Conference on High Energy Nuclear Physics that was held at the University of Rochester on April 15-19, 1957. The purpose of the Annual Rochester Conference, to quote from the Foreword of the book, "is to bring together a representative group of active workers from high energy physics laboratories throughout the world for an informal complete discussion of the experimental and theoretical developments of the previous year". That this object has been fulfilled admirably is apparent even from a casual look at the contents of the papers submitted during the Conference and from the names of the participants who represent the most active workers in the subject at the present moment.

The Conference was divided into eleven sessions, each devoted to discussion on a special aspect of nuclear physics. The report of each session starts with an introductory survey by a moving speaker and is followed by the presentation of papers by other workers in the field, with discussions interspersed between them which are both informal as well as highly technical. The opening session bears the title, "Structure of Nucleons" and in it we find a survey of the two regions into which it has now become customary to divide the nucleus, namely the outer part where the π mesons predominate and for which the Yukawa picture gives a good basis, and the "inner core" where, it is believed that our present notions of space and time break down.

Session II (or Chapter II) deals with pion reactions. The third session devoted to "Nucleon-nucleon interaction" contains an interesting account of the nature of nuclear

potentials and a number of papers on the scattering of nucleons by nucleons and polarization experiments. In his introductory survey, Professor Marshak shows that a potential which is a mixture of central, tensor and spin orbit forces gives a good fit of the experimental data on two nucleon interaction upto an energy range of 150 Mev.

The most spectacular development in elementary particle physics during the last year is the fall of the conservation law of parity, and the Proceedings of the Session entitled, "Weak Interactions" with C. N. Yang as the Chairman and Professor Lee as the moving speaker should therefore prove to be particularly pleasing and interesting. In this chapter we have a review of the two component theory of neutrino and the conservation laws of physics in general, and surveys on the classical experiments like the beta decay of polarized Co^{60} nuclei, which demonstrated conclusively the non-conservation of parity in weak interactions.

Another important development of recent years relates to the discovery of anti-proton and the chapter entitled "Antibaryon Phenomena" gives an account of the production of these particles, the nature of their interactions and experiments relating to their scattering cross-section. Besides, the volume contains reports of several sessions on strange particles and their interactions, and a chapter in theoretical physics in which is presented amongst other papers a review by Schwinger on the structure of Green's functions.

The volume records every remark made by the participants of the Conference and this conversational style gives one the feeling of living through the Conference. The book will undoubtedly be welcome to all workers in field theories and to experimental physicists working in nuclear or cosmic ray physics.

K. S. V.

Safety Techniques for Radioactive Tracers. By J. C. Boursnell. (Cambridge University Press), 1958. Pp. xi + 68. Price 7 *sh.* 6 *d.*

With the increasing application of tracer techniques in the field of experimental biology, medicine and chemistry, a handy publication, dealing with safety and precautionary measures to be followed in handling radioactive isotopes, is a welcome one and the book under review is such a publication that has been brought out by the Cambridge University Press.

A hot laboratory is a place where an active consignment is dealt with and disposed off for subsequent use, in a cold laboratory, and therefore the contamination and health hazard is more serious in the former than in the latter. A very brief summary of the types of radiations and their harmful effects, and the routine precautions such as wearing film badges and the periodic blood check-ups are set out in the earlier part. Under contamination and cleanliness, very useful tips, and methods to be followed in the 'hot' as well as 'cold' laboratories are fully dealt with, including a small section on disposal of waste.

The most useful part of the book is to be found at the end where summary of recommendations, maximum permissible levels for contamination in laboratory handling, classification of radioactive isotopes by toxicity, a few laboratory ware and dose levels are set out in a highly condensed form. A bibliography is also appended at the end where references to other publications and original papers dealing with the subject of tracer methods and radiation hazards are presented. This book should be possessed and carried by all workers who are dealing with radioactive material.

The Measurement of Colour. Second Edition. By W. D. Wright. (Hilger & Watts, Ltd., London), 1958. Pp. ix + 263. Price 52 *sh.*

As one of the earliest authoritative treatises on the principles, methods and applications of the trichromatic system of colour measurement, the first edition of this book has occupied a very well-defined place on the bookshelf of every serious student of optics. The present volume is, accordingly, a timely revision of what has long been considered a standard text-book on this subject.

The opening chapters of the book are of an introductory nature and deal with radiation in the visible spectrum—its emission, absorption and reflection, and its reception by the eye. They are followed by what is virtually the core of the book, which has now been rewritten in the form of two chapters. The first deals with the principles of photometry and the theoretical and experimental basis of trichromatic colorimetry, while the second deals in more detail with the C.I.E. system of colour measurement. This chapter includes sections on the definition of the standard observer and the standard reference stimuli, as well as a description of the procedure followed in computing tristimulus co-ordinates from spectrophotometric data. Reference is also made to the specification of colours in terms of dominant

wavelength and purity, a system which has advantages for some applications.

The next two chapters are devoted to descriptions of some of the better known types of colorimeters and spectrophotometers, and a discussion of the problems of subjective judgements of colour differences and the construction of a suitable atlas of colours. The Munsell system, in particular, is dealt with in some detail. This is followed by a new chapter dealing with the application of colour mixture data to three colour reproduction, with particular reference to colour television and colour photography. This appears an opportune addition, in view of the attention which is now being bestowed on these subjects.

The concluding chapter of the book is an outline of some of the applications of colour measurements. It includes sections on the analysis of interference and polarization colours, the apparent colours of objects seen at great distances and the phenomenon of dichroism, as well as on the use of colour measurements in such obvious fields as the quality control of signal glasses, paints and dyes, and in some other, not so obvious, fields as agriculture, food packing and the paper industry.

The general standard of production of this volume is quite high and it is profusely illustrated. Other features are comprehensive references, a full index and four appendices which include several useful tables. With the increasing use of the trichromatic system of colour measurement in science and industry, this volume is certain to prove an invaluable reference work to a large circle of readers.

P. HARIHARAN.

Encyclopedia of Chemical Technology—First Supplement Volume. Edited by Raymond E. Kirk and Donald F. Othmer, Assistant Editor: Anthony Standen. (Interscience Publishers, Inc. Agents in India: Asia Publishing House, Bombay-1), 1957. Pp. xviii + 974. Price $ 25.00.

No less than fifteen volumes have appeared under the above title, comprising of a comprehensive summary of industrial knowledge on materials, methods, processes and equipment for the chemist and the chemical engineer, contributed by more than 1,000 experts. In an ever-expanding age of technology new materials, new methods, and new processes are continuously pouring in and the publisher is therefore faced with the problem of bringing such publications up to date.

The matter under review is the first supplement volume that has been got up by the publishers to include articles on subjects of wider interest, to add some more individual substances that have commercially become important in recent years and to discuss certain reactions and unit operations such as cyanoethylation, fluidization, etc.

The application of servomechanism principles to chemical processing can result in automatic process control, while the application of operation research methods will result in optimum production scheduling. This combined application is called automation or systems of engineering. Under automation certain basic conceptions are discussed. Computors which are finding increased industrial applications in recent years are briefly treated.

Quite fittingly in this volume under nuclear reactors, a fairly detailed account of the several types of reactors currently in use and the engineering problems arising out of the specialised nature of reactor technology are presented. An article on solid state describes recent advances in this field such as semiconductivity, imperfections in solid state, sintering processes and solid state reactions all of which are greatly significant and are already beginning to bear fruit in improved chemical technology. Certain other subjects dealt with, *viz.*, photovoltaic solar converters, solar energy, water demineralisation are of immense interest and promise great future possibilities.

The fifty-one articles appearing in this supplement volume are arranged alphabetically and contain cross-references to the original volumes as well as to this volume. The volume is beautifully got up in art paper as its predecessors and bears the stamp of top-class production.

It is highly regrettable to hear that Dr. Kirk, the Senior Editor, passed away in February 1957, who until shortly before his last illness was concerning himself with this volume. The sixteen volumes are a tribute to his genius as the editor, which capacity he shared with D. F. Othmer.

A. J.

Carnegie Institution of Washington, 1956-57.

The Year-Book under review presents the excellent work turned out by the chain of laboratories of Carnegie Institution of Washington, during the year 1956-57. Research in these laboratories is mainly carried out in branches like Radio Astronomy, Terrestrial Magnetism,

Geophysics, Plant Biology, Embryology, Genetics and Archæology. Diversity of approach is the very life-blood of the scientific effort. Carnegie Institution rightly enlists men of most unlike temperaments and talents. These, and many other circumstances and the fact that the whole of the Institution's work is pointed towards the end of uncommitted research, fit it peculiarly to assist in the major task of scientific synthesis.

The Institution has been keeping in pace with the rapid advances made in science. Analysis of fine structure of solar radio emission, study of Jupiter as a source of radio noise, to obtain a detailed knowledge of the nature of radio sources, and the actual construction of a radio telescope to be equipped with a 60-foot dish, have been some of the interesting programmes undertaken by Mount Wilson and Palomar Observatories and in the Department of Terrestrial Magnetism. The problem of the determination of the age of the rocks has engaged the attention of several earth scientists since last few years. In the geophysical laboratories of the Institution, particular emphasis has been given to the means made available by the natural radioactive decay of potassium to argon; and of rubidium to strontium. A striking specific finding in the past year in this area of research has been the establishment; by concordant rubidium-strontium and potassium-argon datings, of an age of about 340 million years for the micas in a number of granitic rocks. Phase equilibrium relations among the major rock-forming mineral groups, study of the kinds of patterns that might be obtained in various types of order-disorder in crystals, methods of absolute counting of β radioactivity continue to be some of the major investigations in the geophysical laboratory.

The Carnegie Institution is further interested in fundamentals of biology. Synthesis of amino acids from simpler components under conditions simulating those believed to have obtained on the earth in the remote geological periods has been their pioneering work. Perhaps the most dramatic findings of the biophysics group for the year has been the demonstration that under appropriate conditions rather large particles containing nucleic acids, proteins and lipids can be made to form 'spontaneously' from disintegrated cellular material. The Department of Plant Biology has long maintained a central concern with the nature of the photosynthetic pigment chlorophyl as it occurs in the living plant. Laboratory analysis and studies of the Department of Archæology have revealed significant facts of the Maya culture.

The creation of an environment to conduct researches in fundamental sciences is the task to which the Carnegie Institution is dedicated; and for which it is unusually equipped. The Institution has already accomplished much in the direction of progress of science, and its task in the future will be yet greater.

S. BALAKRISHNA.

Antibiotic Annual, 1957-58. Edited by Henry Welsh and Felix Marti-Ibanez. (Medical Encyclopedia, Inc., New York, N.Y.) (Distributors outside U.S.A.: Interscience Publishers, Inc., New York; India: Asia Publishing House, Bombay), 1958. Pp. xvii + 1070. Price $ 12.00.

The Antibiotic Symposium in Washington has become an annual feature and the present volume is a record of the Fifth Symposium held on October 2, 3 and 4, 1957. It represents what the people assembled there "have thought, and done and what they contemplate doing further in the antibiotic field"—in short, the way in which the wind blows in this extensive field of antibiotic medicine. There are 161 papers besides 3 panel discussions, a large percentage of which emanating from the U.S.A. The studies presented relate to novobiocin, vancomycin, amphotericin B, tetracycline phosphate, antibiotic combinations (with oleandromycin being the interested partner), use of penicillinase for treatment of toxic reactions due to penicillin, a national survey of toxic reactions due to antibiotics (this article being since reproduced in *Antibiotic Medicine*), use of gamma globulin with antibiotics, etc. The new antibiotics reported are: ristocetin, quinocycline complex, telomycin, pimaricin, sulfocidin and three antifungus polyene antibiotics. The Randall Lecture of Dr. Jawetz is on "Patient, Doctor, Drug and Bug" the "four main participants in the daily drama" involving infectious diseases and their treatment. In this, we learn that our flesh is heir to 2,936 reported illnesses and complaints and that antibiotic administration was warranted for less than half of these. The reviewer agrees with and underlines the conclusion that "all conceivably available fixed contractions of antibiotics, whatever their claims and purported benefits, have far more disadvantages than merits". Some papers in this volume also will bear this out. There are reports on three panel discussions on "Rheumatic fever prophylaxis", "Host resistance and

chemotherapy" and "Antibiotics as antitumour and antiviral substances". We have yet to discover antibiotics of definite value against the virus infections and cancer. The tremendous amount of work going on in this direction could be realized from the fact that the screening programme costing 3 to 3·5 million dollars and involving about 2 million mice, evaluates 30,000 beers per year. It is reported that about 10% of these show some activity. We hope something will come out of this colossal programme of work. Antibiotic research seems to be a never-ending affair. As Marti-Ibanez says, "our problem is to develop fresh weapons for combating diseases in general and infectious diseases in particular. This is a scientific problem. We want also to render these weapons into instruments that will help us to understand the actual history of a disease and the biological cycle of its causal germs. This is a historical problem for it affects the knowledge and advance of our time". We have to do quite a lot of work to do justice to this great programme of work.

K. GANAPATHI.

The Invertebrata. Third Edition. By L. A. Borradaile, F. A. Potts, L. E. S. Estham and J. T. Saunders. Revised by Dr. G. A. Kerkut. (Cambridge University Press), 1958. Pp. vii + 795. Price 55 *sh.* net.

We welcome the third edition of *The Invertebrata*, revised by Dr. Kerkut, a text-book which has been holding sway for over a quarter century. Undoubtedly the book under review is a comprehensive treatise, bringing under its purview an organized account of an array on invertebrate phyla. Aimed at providing an advanced account of anatomy and physiology of invertebrate animals at the University level, the book naturally does not deal in detail with the types described in elementary text-books.

Certain innovations have been resorted to. The acœlomate group comprehends phyla like Nemertea, Nematoda, Nematomorpha, Acanthocephala, Rotifera, Gastrotricha, Kinorhyncha, Priapulida and Endoprocta. Ectoproct polyzoa are treated under minor cœlomata along with Brachiopoda, Chætognatha and Phoronidea. The Protochordata include the Graptolita as these appear to show greater affinities with them. Onychophora and Trilobita are treated together as classes in Chapter X. There is a chapter added in this edition; it deals with relevant literature to which the student is initiated, should he desire additional information. A few of the more important scientific journals are also listed.

We are sure that the new edition of *The Invertebrata* with some chapters rewritten (Insecta) or expanded so as to include recent findings in the various invertebrate phyla will be as popular as before. As the book is a mine of information, we have no hesitation in recommending the addition of the same to all zoological libraries. The college student cannot find a more useful and authoritative text-book than the one under review. We should, however, point out that for the Indian student, the book is priced rather high.

L. S. R.

The Mulching of Vegetables. By Patricia Rowe-Dutton. (Technical Communication No. 24, Commonwealth Bureaux of Horticulture and Plantation Crops, East Malling, Kent), 1957. Pp. xiv + 169. Price $ 2.80.

This is a sequel to an earlier publication of 1955 on effect of mulching on soil properties and stubble mulch farming. The range of mulching material discussed in the book extends from natural substances such as plant residues, peat manure, stones, etc., to manufactured materials including asphalt, paper, glass wool, aluminium foil, bituminous emulsion and polyethylene plastic. In an introductory chapter the purposes and effects of mulching on moisture conservation, weed control, temperature regulation, winter protection, etc., are discussed. According to the author the publication lays stress as much as possible on practical aspects and on any general trends of horticultural significance that have emerged.

The following eleven chapters deal individually with various vegetable crops such as Asparagus, Brassicas, Cucurbits, Onions, Peas and Beans, Potatoes, Egg plant (Brinjal), Tomatoes, etc. The special feature of the book is that each chapter after discussing the results of mulching experiments finishes with a summary and the economics of mulching. Though the data discussed in the book mostly refer to experiments in centres where market gardening is very highly developed, there is useful information available to vegetable growers in underdeveloped countries of Asia, particularly those who deal with onion, potato and tomato. It may be mentioned in this connection that growing of onions with a rice straw mulch is an established practice in parts of the Philippines. Straw mulching is also extensively

practised by vegetable growers near about Bangkok in Thailand. K. R.

Looking at Chromosomes. By John McLeish and Brian Snoad. (Macmillan & Co., Ltd., London), 1958. Pp. 88. Pl. 48. Price 16 *sh.*

This is a delightful pictographic account of chromosome behaviour during cell division and germ cell formation in *Lilium regale* intended to stimulate the interest of beginners in biology. Short crisp descriptions introduce the reader to the beautiful photographs illustrating the various stages.

In an objective presentation, the dogma: "All the cells of an individual contain identical complements of chromosomes and therefore of genes" (p. 3), should have been avoided. We warmly recommend the book to the novice in spite of its high cost.

M. K. SUBRAMANIAM.

Books Received

Three Steps to Victory. By Sir Robert Watson Watt. (Odhams Press, Asia Publishing House, Bombay-1), 1958. Pp. 480. Price 30 *sh.*

Monographs on Mechanics and Applied Mathematics—An Introduction to Fourier Analysis and Generalised Functions. By M. J. Lighthill. (Cambridge University Press, London N.W. 1), 1958. Pp. viii + 79. Price 17 *sh.* 6 *d.*

Monographs on Physics—Mass Spectroscopy. By H. E. Duckworth. (Cambridge University Press, London N.W. 1), 1958. Pp. xvi + 206. Price 35 *sh.*

Microchemical Journal, Vol. I, Issue 2. Edited by Nicholas D. Cheronis and others. (Interscience Publishers, New York), 1957. Pp. 167-324. Price $ 9.60 per year.

Memoirs of the Indian Animal Types. I. Dasyatis. (The String Ray.) By Mary Chandy. (Maxwell Company, 66, Gautam Budh Marg, Lucknow), 1958. Pp. vi + 123. Price Rs. 5.

SCIENCE NOTES AND NEWS

How are Temperatures of Million Degrees Measured?

Obviously ordinary thermometers which depend on physical changes in material cannot be used. All substances vaporise at temperatures far below those needed for thermonuclear reactions.

The method used at Harwell and Aldermanston for measuring temperature is by means of a spectroscope. The basis of this method is, that it measures the speed of the nuclei which are contained in the hot gas.

It is possible to measure the speed of the atomic nuclei because they emit light of a definite frequency under high temperature. This light can be seen as a bright blue glow in the torus, and can be analysed by means of a spectroscope. The frequency of the light depends on the speed of the source, just as the frequency or pitch of the whistle of a passing train depends on its speed. This phenomenon, known as the Doppler effect, is made use of in the measurement of temperature.

In the case of the moving nuclei the result of the Doppler effect is to make light which would otherwise be of a single frequency, and which would therefore appear as a single line on a photographic plate, spread over a range of frequencies and appear as a fuzzy line.

By measuring the width or 'fuzziness' of the lines on the photographic plate, a direct estimate of the temperature of the nuclei can be obtained.

A New Spot Test for Nitrate Ion

The well-known diphenylamine and brucine tests for nitrate while sensitive, are lacking in specificity. Other oxidizing agents, such as chlorates and nitrites, give the same colour reaction as nitrate. In both tests the reagent is dissolved in concentrated sulphuric acid and this prevents their use for the detection of nitrate on substrates which might be charred by the strong acid, *e.g.*, on paper chromatograms.

A new spot test for nitrate ion is described. The identification is based on the yellow-coloured product formed when diphenylamine and nitrate, spotted on filter-paper, are exposed to short-wave ultraviolet radiations. The yellow colour is probably due to products formed during the photochemical reaction. The reaction appears specific and relatively sensitive making it possible to detect 1 g. of NO_3^- in 0·01 ml. of solution.

World Meteorological Organization to Study Tidal Waves

A worldwide study of tidal waves aimed at setting up an international warning system was agreed upon at the recent meeting in Geneva of the Executive Committee of the World Meteorological Organization.

Tidal waves are caused by underwater earth tremors, tropical storms and other geophysical phenomena, and often cause enormous destruction and loss of life in coastal areas. For this reason, the Committee considered that international investigations are necessary regarding the formation of tidal waves, and that results of research should be exchanged between all nations. This would eventually lead to the planning of an International Warning Service.

The International Union for Geodesy and Geophysics was invited to deal with oceanographical and seismological aspects of the problem.—UNESCO.

X-Ray Image Intensifier

Image intensification presents two possibilities: (1) Greater brightness, the normal examination method being largely retained, but without any great dose reduction. (2) Greatest possible dose limitation, necessitating certain concessions as regards method of examination. The superiority of the image intensifier is manifested in fluoroscopy, especially in the case of great contrasts. Serial exposures are possible just as before. "Aimed" exposures in body areas that were formerly less accessible to X-ray examination (petrous bone, etc.) can easily be effected. Special apparatus for the resetting of fractures, heart catheterization and television are described.

Instead of direct observation, the fluorescent image can be photographed or filmed. For single exposures the procedure is of limited value. On the other hand, cineradiography has found great application, particularly in examinations of the digestive tract. A special image intensifier with an 11-inch (28 cm.) diameter screen has been developed for cineradiography of the entire heart.

The advantages of an X-ray cine-film lies in the possibility it offers of studying not only movement but also a very large number of individual images.

Cineradiography will win for itself a permanent place among routine methods of examination. It is not unlikely that the future will see the conventional fluorescent screen permanently replaced by the image intensifier.

The limitation of the X-ray dose received by both patient and operator will continue to be an urgent duty.

Albomycin and Grisein

The first account of a new Russian antibiotic, albomycin, in the English language was a paper by G. F. Gause in *British Medical Journal*, 1955, 2, 1177. Very remarkable properties were claimed for this substance, including an activity against staphylococci ten times more powerful than that of penicillin.

These authors have shown that albomycin is closely related to, if not identical with grisein. Both are amorphous red substances containing iron and amino-acids, and both are separable into four active constituents. Their chemical and physical properties are as nearly indistinguishable as would be expected of two samples of the same substance having different degrees of purity: their antibacterial spectrum is the same, and organisms resistant to each are also resistant to the other. Grisein was discovered by Waksman and his colleagues eleven years ago.

Pyrethrum

An age-old natural insecticide harmless to humans and animals is coming back in the news following the increase in resistance to synthetic insecticides and the recognition of possible hazards to public health of toxic residues left by the latter on foodstuffs. It is the daisy-like flower, Pyrethrum. Development of new compounds which have made Pyrethrum considerably more effective and yet cheaper, and the influence of the "Push-button æro-sols" for which Pyrethrum is admirably suited, form the basis of the post-war story of this insecticide.

The widespread use of the synthetic insecticides on a scale never envisaged in pre-war days, focussed attention on the problem of toxic residues on foodstuffs constituting a menace to public health.

African Pyrethrum formulated with modern synergists, such as piperonyl butoxide, was found to be an ideal substance, as it is well known that Pyrethrum is rapidly destroyed in the human body and that it has no cumulative effect.

Plant Growth Regulating Activity of IMSA

Although it was suggested as early as 1938 that an indole derivative, to be effective as a plant growth regulator, should possess a terminal carboxyl group in the side chain, or a

group readily convertible to a carboxyl group, it has become increasingly evident in recent years that some derivatives of indole which are effective as plant growth regulators do not meet this requirement.

3-Indolemethanesulfonic acid (IMSA) was found to be an active plant growth regulator in a wide variety of growth regulant assays. The compound induced leaf modification, stem curvature, and proliferation of intact tomato and bean seedlings, promoted growth of Avena first internode sections, induced curvature of slit pea sections, and suppressed the elongation of roots of cucumber seedlings. In preliminary weed control experiments, IMSA at 5 and 10 lb. per acre applied as a pre-emergence herbicide controlled both grass and broad-leaved weeds in broccoli, mustard, radish, and cabbage plantings with no injury to radish and slight injury to the remaining crops. Applied as a post-emergence herbicide, IMSA at 10 and 20 lb. per acre controlled broad-leaved and grass weeds in soyabean, corn and oat crops with no injury to oats, slight injury to corn, and severe damage to soyabeans. (*Cont. Boyce Thomson Institute*, Vol. 19, March 1958.)

Antibiotics in the Whaling Industry

A new chemical product was introduced into the whaling industry quite recently. Whaling men were shown how an antibiotic could be used to prevent decay and so save them the loss of a large part of their catch.

After the kill, carcases are flagged and left floating in the water. For some of them, however, it may be several days before they reach land or a ship; and as a result, due to bacterial decay accelerated by the heat retained in the whale's body, anything up to half the value of the carcase may be lost.

Some while ago, in the far north of Norway, a demonstration was given of how to retard the progress of this decay and get the whales cut up before spoilage cost the whaling companies a large part of their profits. The carcases were injected with a special whaling formulation of the antibiotic oxytetracycline ('Biostat') before being towed away. The preparation spread quickly from the point where it was injected through the whole of the whale's body. On arrival at the flensing station much of the carcase which would ordinarily have been lost through spoilage was found to have been successfully preserved.

Preservation with an antibiotic can therefore be expected to play an important part in the future progress of the industry.

Salk's Contribution to Cancer Research

While looking for improved methods of producing his polio vaccine, Dr. J. E. Salk, of Pittsburgh, Pennsylvania, has made an important contribution to cancer research. He seems to be on the way to success in preparing a serum which will attack tumour cells.

The Salk polio vaccine is made by growing the virus in cells from monkey kidneys which are kept alive in special nutrients.

Salk's experiment consisted in injecting millions of the cancer-like cells into monkeys. In most cases nothing at all happened; but in some of the animals tumours started to grow and then disappeared again. The monkeys were able to fight the invading cells successfully.

As a rider to this experiment Salk tested the blood serum from these monkeys to see what effect it had on the proliferating cancer-like cells. It immediately killed them, but did not affect healthy kidney cells.

Here then is the basis for a cancer vaccine which will act specifically against cancer cells. Unfortunately, there is one snag which prevents the method being developed for treating humans. Unless the cancer cells are injected into the same animal (in this first case a monkey) as that from which they were originally obtained, the serum obtained kills both normal and cancer cells. But Dr. Salk indicates several possible solutions to the problem and there can be little doubt that an antiserum which acts only against certain cancer cells will be available in due course. (*The New Scientist*, Jan. 1958.)

Gibberellic Acid and Plant Growth

Gibberellic acid is a white crystalline solid of total formula $C_{19}H_{22}O_6$ and melting point 223-35° C. It is soluble in water to the extent of 5 g. per litre to give an aqueous solution of pH 3-4. It is stable when dry but unstable in aqueous and aqueous/alcoholic solutions.

One unique property of gibberellic acid, that of increasing the growth of plants by greatly elongating the cells, was first discovered by the Japanese pathologist, Kurosawa, in 1926.

Studying the symptoms of the bakanæ or 'foolish seedling' disease of rice Kurosawa observed that the casual pathogen was a soil-borne fungus, *Gibberella fujikuroi* which caused infected seedlings to grow very much taller than healthy ones. The culture filtrate when sprayed had the same effect. Other Japanese biologist showed that the filtrate would induce excessive growth in many other plants as well

as rice. These discoveries attracted very little attention until a few years ago it was taken up at the Akers Research Laboratories of Imperial Chemical Industries. The research workers at I.C.I. succeeded in preparing a highly active growth-promoting substance from a culture of *Gibberella fujikuroi*.

The biological activity of the chemical has been widely investigated in Japan, Great Britain and the United States. Studies are continuing in the United States, the United Kingdom and in many other countries on a very wide variety of crops. These studies are both fundamental and applied, and should lead to a much more complete understanding of the properties and possible uses of gibberellic acid.

Radio Isotopes Training Course

As a United Nations Regional Technical Assistance Project, a specialized training course in "Radio-isotopes" will be held in Tokyo (Japan) from 23rd August-19th September 1958. The UNESCO South-East Asia Science Co-operation Office in Djakarta and the Government of Japan are sharing responsibility for organizing this course. Governments of the region are being approached concerning their interest in participating in this training course.

International Congress of Industrial Chemistry

The Thirty-First International Congress of Industrial Chemistry will be held from September 7th to 20th, 1958, at LIEGE, an industrial city situated 100 km. from Brussels and possessing numerous and important installations of the Belgian Chemical Industry.

Organised with the collaboration of the *Federation des Industries Chemiques de Belgique* (Federation of Belgian Chemical Industries) this Congress will once again enable fertile contacts to be formed, or renewed, between those engaged in the scientific, technical, and industrial development of Applied Chemistry.

The following Groups and Sections have been formed: Group I: General Technical Problems of the Chemical Industry; Group II: Fuels; Group III: Nuclear Sciences; Group IV: Metallurgy; Group V: Industrial Chemistry of Minerals; Group VI: Cements, Building Materials, Glass-making; Group VII: Organic Chemical Industries; Group VIII: Food and Agricultural Industries; Group IX: Colonial Problems; Group X: Industrial and Social Organization.

Further information can be had from the General Secretarial Office, 32, rue Joseph II, Brussels IV (Belgium).

Award of Research Degrees

Andhra University has awarded the D.Sc. Degree in Zoology to the following candidates for their theses indicated against each: Shri R. Nagabhushana Rao, "Studies on Marine Wood-Boring Mollusca of Visakhapatnam Harbour"; Shri K. Hanumantha Rao, "Studies on Parasitic Worms of Fishes and Piscivorous Hosts from Andhra Pradesh"; D.Sc. Degree in Botany to Shri R. L. N. Sastry for his thesis entitled "Floral Morphology and Embryology of Some Ranales"; and the D.Sc. Degree in Chemistry to Shri S. K. Pavanaram for his thesis entitled "Synthesis of Furanobensopyrones and Chemical Examination of Indian Heart-Woods".

The Annamalai University has awarded the Ph.D. Degree in Chemistry to the following candidates for their theses indicated against each: Mr. T. S. Govindarajan, "Ultraviolet Absorption Spectra of Thiophenols and Aryl Sulphides"; Mr. K. M. Somasundaram, "Dielectric Contribution to Liquid Miscibility".

The University of Poona has awarded the Ph.D. Degree in Chemistry to the following candidates for their theses mentioned against each: Shri A. K. Das Gupta, "Diffusion and Evaporation of Trace Impurities from the Matrix of a Host Lattice"; Shri K. G. Gore, "Experiments in Benzopyrones"; Shri V. G. Naik, "Synthesis of Nitroflavonols".

Corrigendum

The note entitled, "The Effect of Certain Insecticides on Larvæ of *Anomis sabulifera* Guenther", published in the May 1958 issue (Vol. 27, No. 5, pp. 179-80) and the paper No. 2 under reference are actually the work of Dr. N. Dutt and Shri R. N. Ganguli, reported to the Indian Science Congress (*Proc. Ind. Sci. Congr. III*, 387, 1956).

The authorship should, therefore, be read as N. Dutt and R. N. Ganguli.

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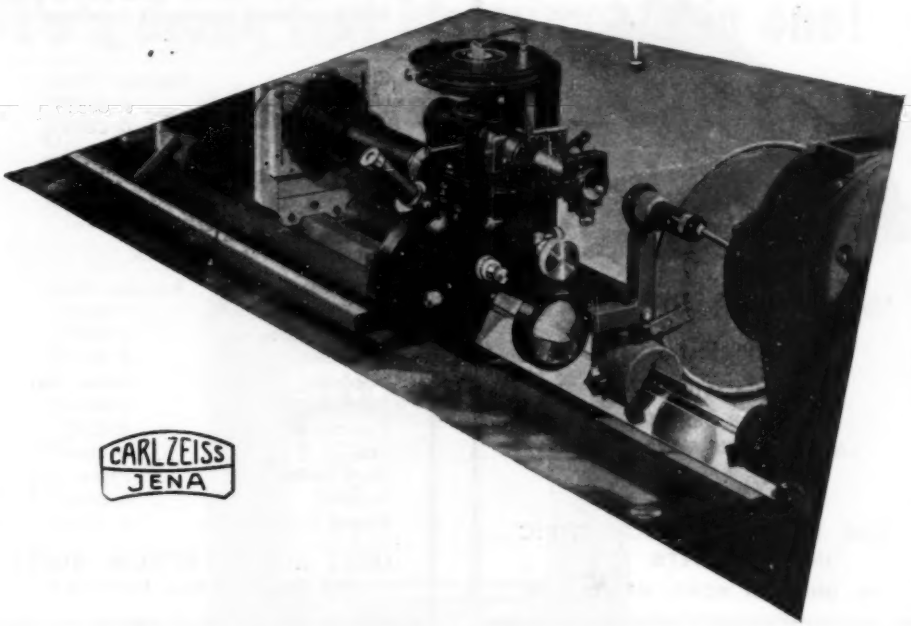

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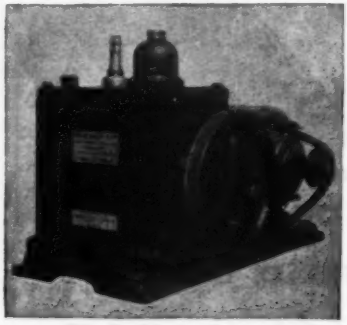

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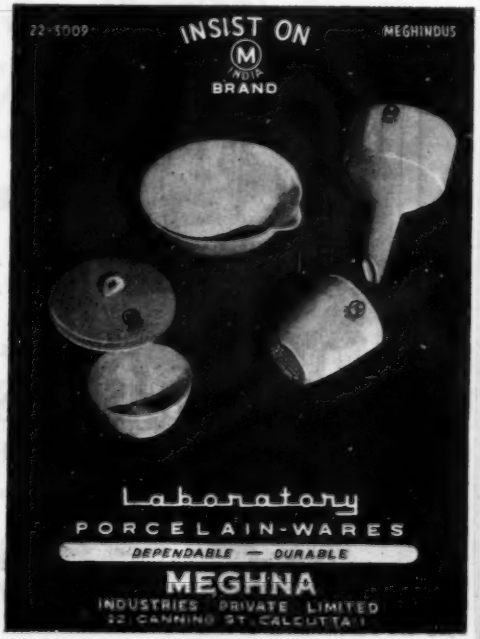

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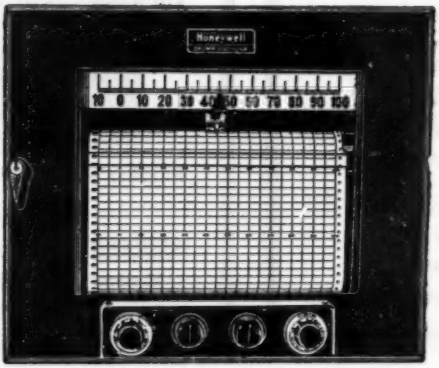

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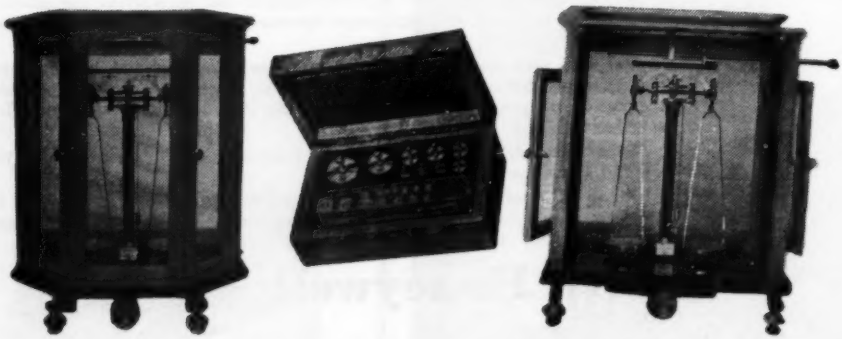

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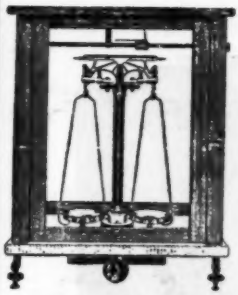

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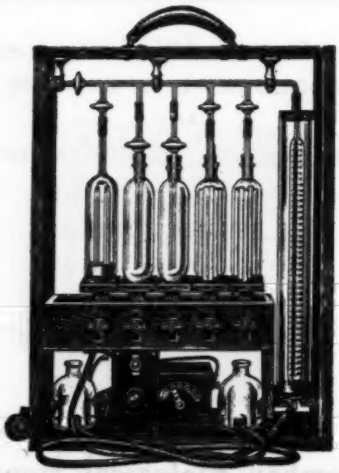

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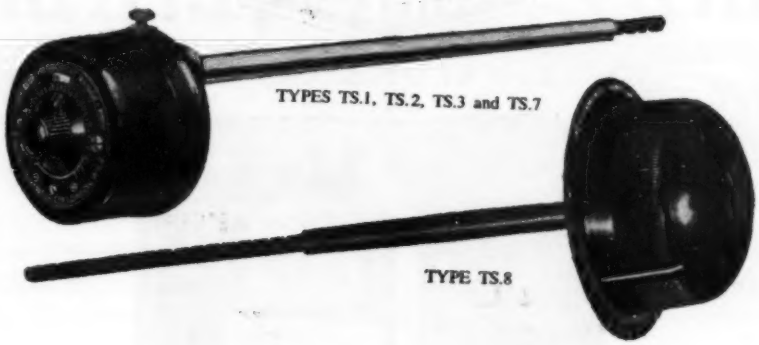

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